APPLIED
HYDRAULICS
THE MAGAZINE OF FLUID POWER

JULY 1954

INCLUDING AIR CONTROLS
AND AIR CIRCUIT DESIGN
• ELECTRICAL CONTROLS

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Control Circuits for Fluid Power Transfers . . . page 55

Mechanical Designs on Transfer Machines . . . page 58

Air Operated Turnover Pays Off in 11 Weeks . . . page 62

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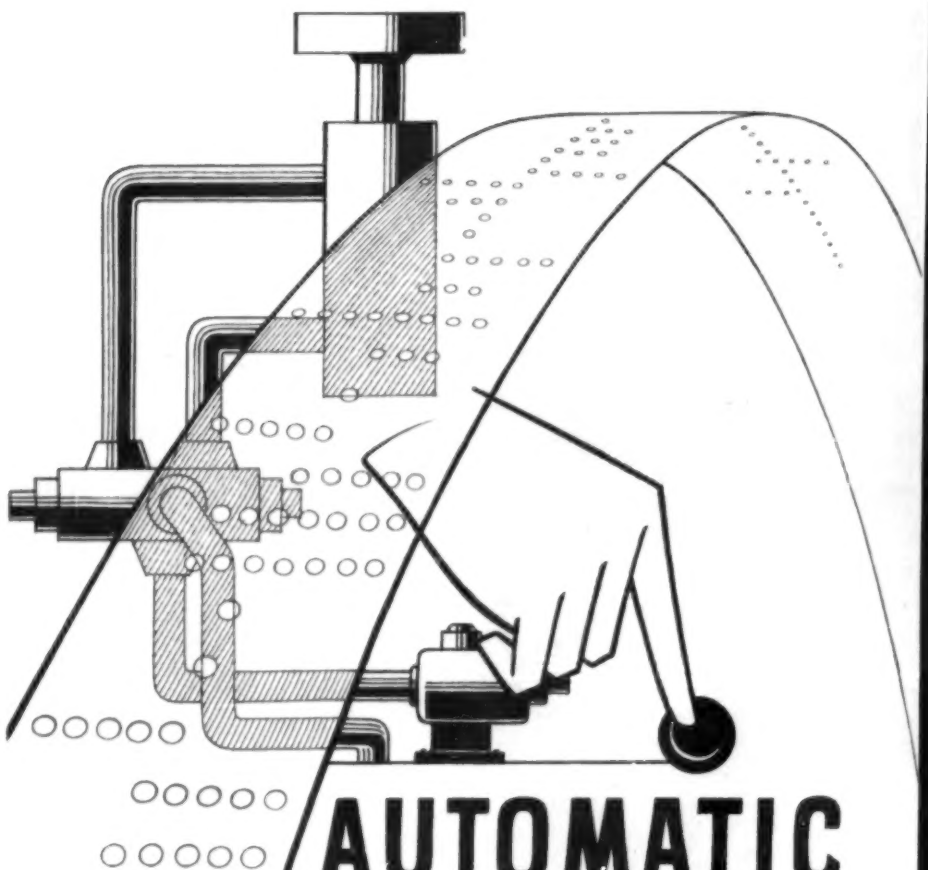

AUTOMATIC MACHINERY ISSUE

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But So Are Fluid Line Problems

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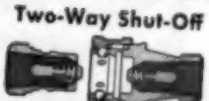

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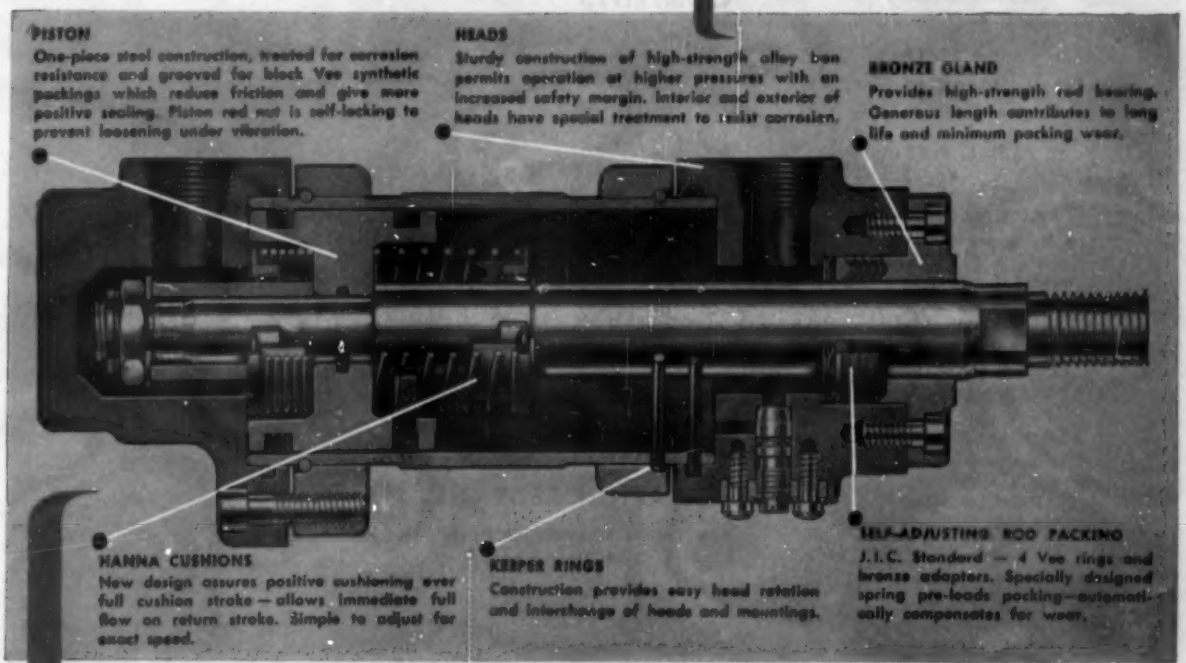
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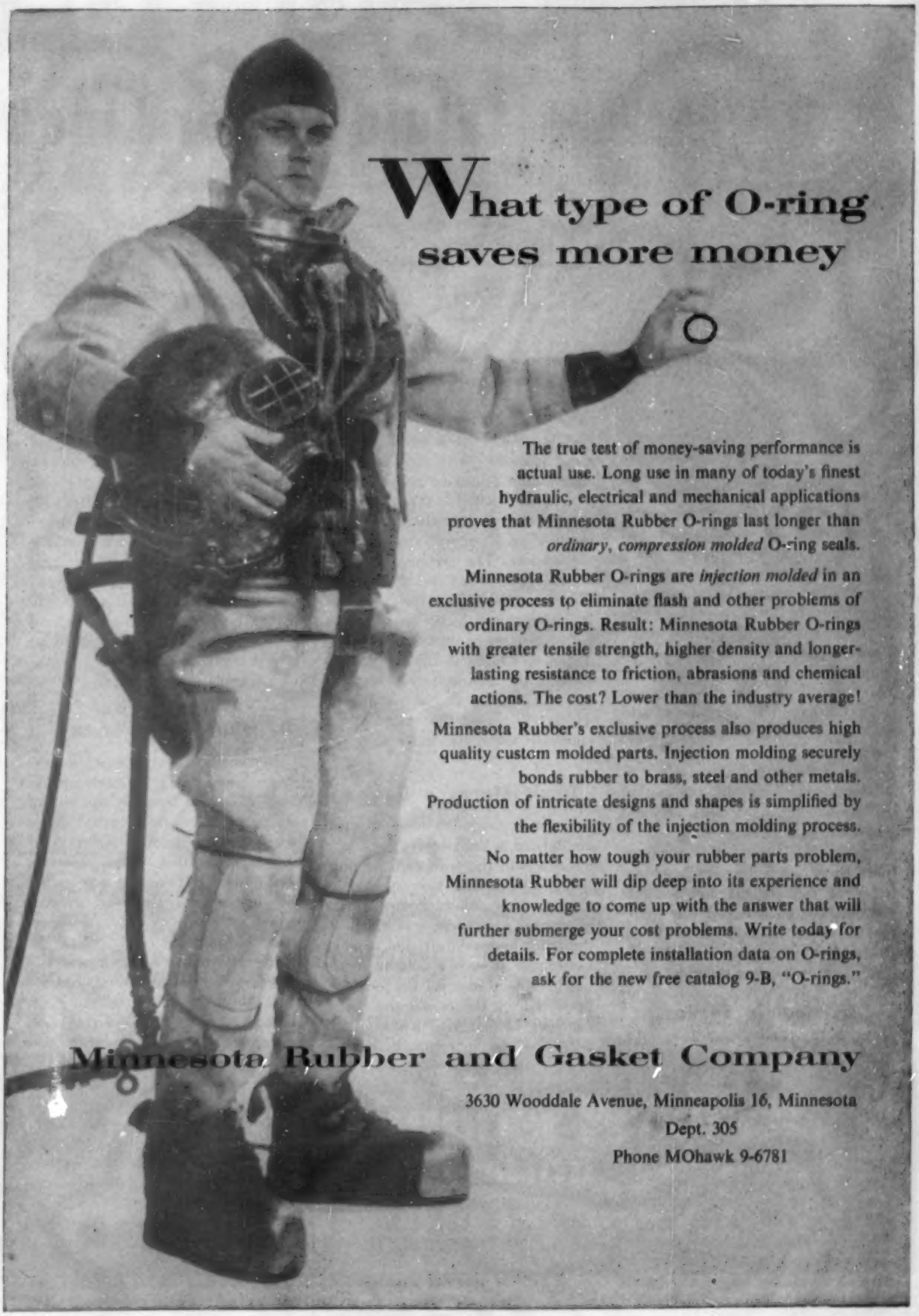
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APPLIED **HYDRAULICS**

Fluid Power Lines

Automatic Machinery Issue

Our lead article this month says we don't think there is anything new about the idea of mechanization or automation. However, there is a great deal new about the design and application of automatic machinery. Each month APPLIED HYDRAULICS keeps you in touch with design and application ideas for air and hydraulically powered equipment. This month, we've grouped a series of articles which illustrate the use of fluid power on transfer devices, fully automatic machines, semi-automatic machines, material handling equipment, and machinery used in processing equipment.

The articles on automatic machinery emphasize the integration of electrically controlled oil and air powered devices into large work transfer installations. For the most part these machines are combinations of mechanisms and controls which have been in use for many years. Recent improvements of controls have been aimed toward making each unit more reliable.

Hydraulic Servos

Ransom Tyler's article in this issue will give you an excellent picture of what a hydraulic servosystem is and how it is being used industrially. Because you'll be seeing more and more applications of oil powered servosystems it will pay you to become familiar with the basic idea of feedback control.

For the future, we look to completely new combinations of electro-hydraulic components to give sensitive servosystems which will be accepted as industrial equipment and will have a realistic price tag.

We were recently given a very impressive demonstration by Don Ericson, Pegasus Laboratories, in Berkley, Mich., of a small, precise servo package. With this package, a hydraulic piston is controlled by a remotely located transmitter. What makes it different from other positioning devices? Accuracy is the answer. The system has positional repeatability of .0005 inch. What's more it is a rigid system. It takes surprisingly large forces acting directly against the hydraulic piston to overcome the light input force at the transmitter. This package is one of the developments which will permit the design of dependable automatic machines.

Don't Marry a Design

We have no hidden desire to write an "advice to the lovelorn column"; besides both the wife and the publisher take a dim view of such a project. Now, along comes Harry Mortenson's excellent article, on redesigning hydraulic circuits, to make us wonder if such a column might not be a good idea for the technical press. Harry points out the disadvantages of marrying a design for life. New developments in components can easily obsolete the best designs.

And what about blondes?

Work Handling Devices

A large part of the design effort in the "automatic line" goes into devices which position the workpiece. Frank Zagar's article includes drawings of the mechanisms used on a typical transfer machine. As a part moves between operations it often has to be turned, clamped, lowered or lifted. Power for such motions can be easily supplied by air or oil with a variety of control systems.

As a contrast to Frank Zagar's article which involves a transfer machine costing over $100,000, we've included a short article showing an air operated work handling jig which cost only $3500 and represents an annual savings of $24,000. In this manner, we want to emphasize the importance of fluid powered devices on equipment at any point in your shop.

Machine Tool Hydraulics Forum

Last month, we attended an excellent session on hydraulic problems. From the report of the forum, starting on page 78, you'll learn what went on. A lot of factors went into making this forum valuable and unusual. There was a prepared list of questions. However, answers and discussions were for the most part spontaneous and brief. Because of limited space it was impossible for the sponsors, Vickers, Inc., to invite all interested companies to send representatives, nevertheless, the attendance was well balanced between machine users and builders.

One conclusion which can be formed from this day and a half forum is that many of the problems associated with hydraulic machinery can and will be solved by education of the user in the care and operation of equipment. This forum represented an exchange of ideas which will contribute greatly to the understanding of oil powered machines.

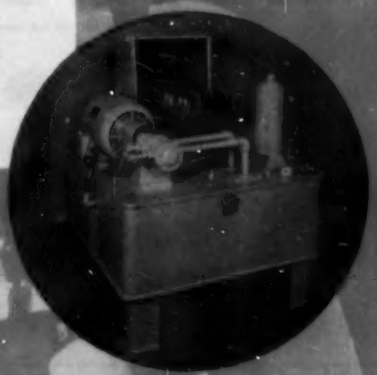
Precision Dyna-seals solve plug sealing problems on NATCO HOLEPAK

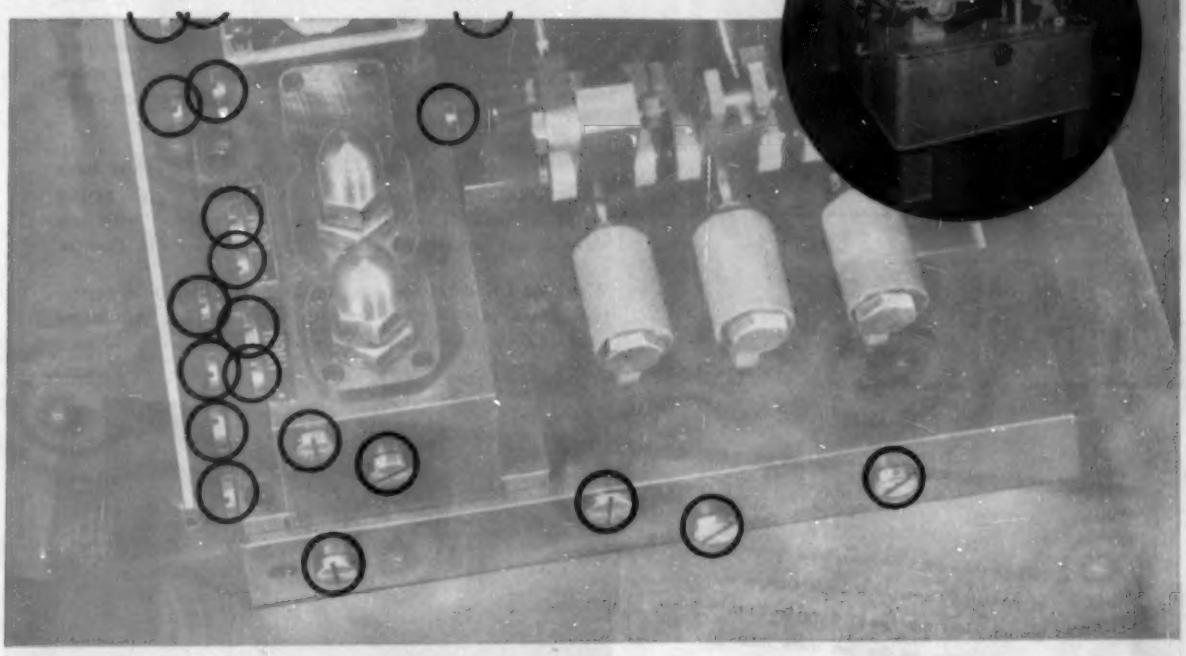
old plug design—

used an "O" Ring in a groove. Plugs were expensive, required close tolerances, permitted leakage.

improved plug design—

uses Precision Dyna-seals. Plugs are inexpensive, tolerances not critical. Assembly is much simpler, leakage eliminated.





National Automatic Tool Company, Inc. found *Precision Dyna-seals* the perfect answer to plug-leakage problems on their "Holepak" Hydraulic Control Units. There are now more than 30 *Dyna-seals* on units like the one shown here!

NATCO's improved design employing *Dyna-seals* has lowered the cost of the plugs—reduced installation and maintenance time—and completely eliminated leakage.

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These are *all* good reasons why Aldrich Pumps have proven their worth over the years with many die casting manufacturers. They are good reasons, too, why you should get more information about Aldrich Pumps.

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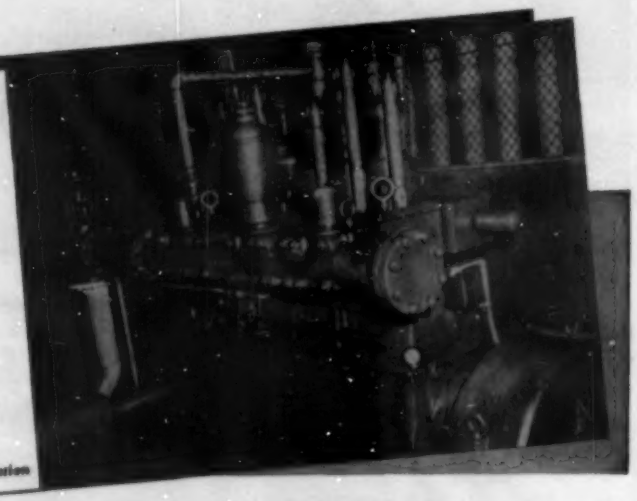
Performance over the long haul is typical of Aldrich Pumps. At a large Eastern die casting plant more than a dozen Aldrich Pumps—some on the job more than 20 years—have established an enviable operating record. Pictured above is one of these pumps—a modern 2¼" x 3", 229 gpm, Direct Flow Quintuplex Pump, now on the line five years.

Photograph courtesy of Doehler-Jarvis Corporation



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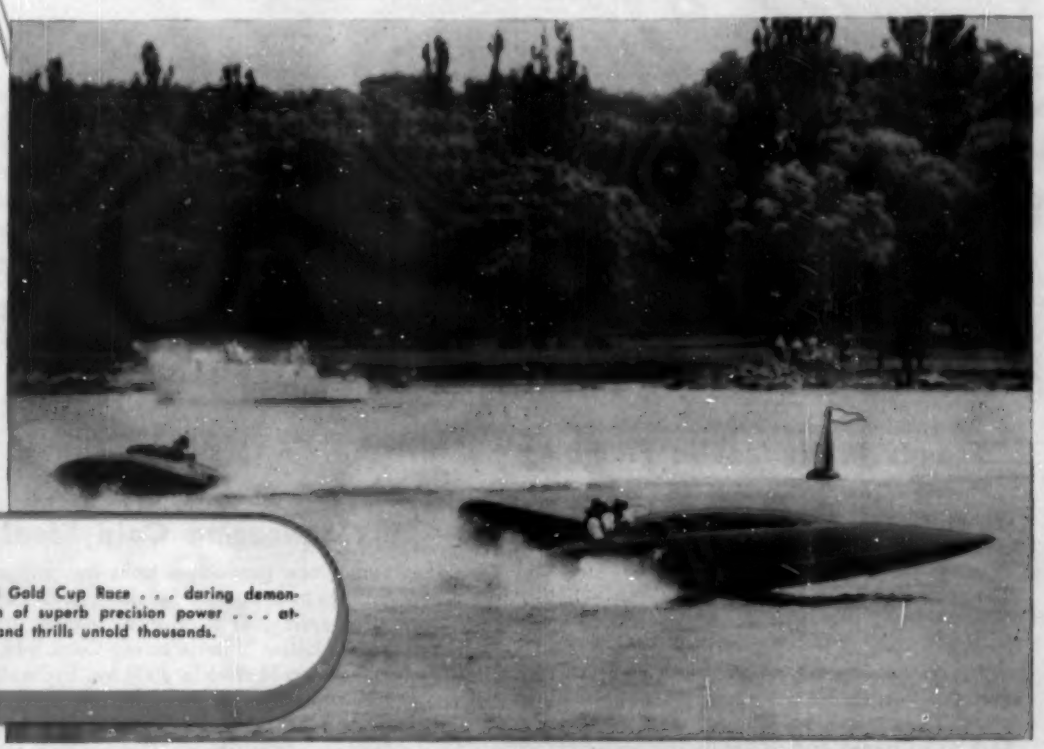

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GROWING HORIZONS FOR FLUID POWER

NEWS • ACTIVITIES • PLANS

"O" Rings as Moving Seals

Because of the relatively short life, some machine tool users have been reluctant to use "O" rings on rotary and reciprocating applications. Development work indicates that good results can be had. One 500 psi, 750 rpm installation reports a life of 1800 hours. Depending on the application, "O" ring life up to 5,000,000 cycles on reciprocating motions has been obtained. Such jobs require special installation techniques and groove designs.

Trends in Hydraulic Plumbing

There are tests going on today which prove that certain types of welded seam steel tube can be used for oil hydraulic pressure systems with the same results presently obtained from seamless steel tubing. The recommendation of this tubing will undoubtedly be considered during the next Joint Industry Conference.

Always looking for ways to minimize leakage, industry is now trying out a new thread form for pipe plugs. The taper is 7/8 inch per foot; the plugs don't have to be tinned and so far results have been excellent. James Robinson, Vickers, Inc., described these plugs at a recent meeting.

High Temperature Seal Symposium

The most critical problem in the design and operation of hydraulic and air circuits for modern aircraft is that of high temperature. The sonic barrier has given way to the thermal barrier. Intensive efforts are being made to find a hydraulic fluid that will operate satisfactorily at temperatures far beyond those called for in the existing specifications. Component materials and design are in a state of uncertainty. In a noteworthy effort to bring together the experience of a number of specialists, particularly suppliers to the aircraft engine field, on work progress in the high temperature static seal field, the SAE Committee AE-1, Joint Aircraft Engine and Accessory Installations, recently sponsored a symposium on Aircraft High Temperature Static Seals for All Media. While seal development for fuels was emphasized, sealing problems with other fluids, including hydraulic system fluids, were covered and discussed.

Perhaps the outstanding interest was in three papers which traced the development and test experience of new metallic seals, two of them all metallic. However, elastomeric seals and the materials and compounding developments which make at least some of the most promising of them satisfactory for some ranges of high temperature applications were ably presented.

The importance of the symposium, which drew over 150 men, was reflected in the high caliber of personnel which the services, the aircraft industry and the supplier industry saw fit to send.

Squeezing Cold Steel

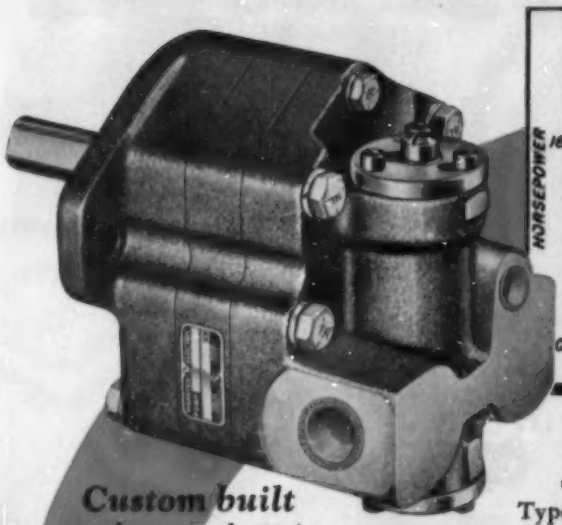
Another new production technique is opening new possibilities to designers. Speaking at the ASTE meetings this spring, D. I. Brown, market development manager, Mullins Manufacturing Corp. told about the squeezing of cold steel in 3000 ton hydraulic presses.

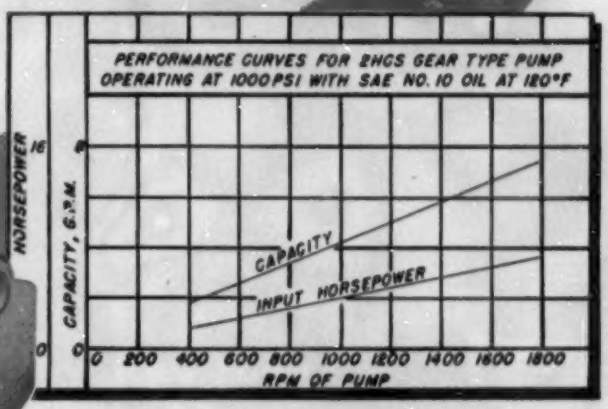
"The advantages of this relatively new method are apparent in the clean designs that are possible with a minimum of operations. The research and development began with experimental production of 105 mm shells in 1950". Brown said. Typical of the products that can be made more economically with cold extrusion of metal, Brown said, are the hydraulic accumulators that are stronger, more precise, yet half as expensive as those made by an older method of welding caps on a tube.

More Dollars for Plant Modernization

Up to now, there has been a tax deterrent to modernization. The House of Representatives Ways and Means Committee has been considering a bill which can greatly assist manufacturers in stepping up plans to replace machine tools. The bill being considered will base the rate of depreciation on a declining balance. A machine will be written off in 10 years; 20 percent the first year and 66 2/3 percent within 5 years. This revision, if and when it is made, will put equipment replacement in proper focus and result in an accelerated modernization program.

Check this typical **WEBSTER** Hydraulic Pump Performance Curve





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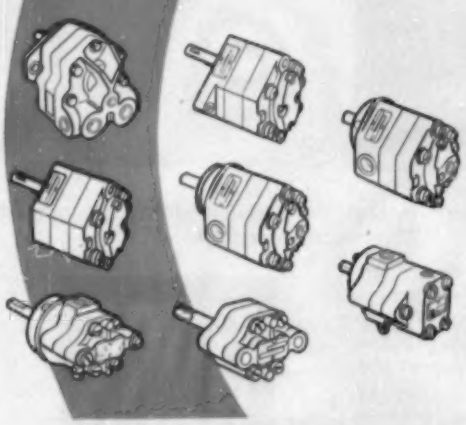

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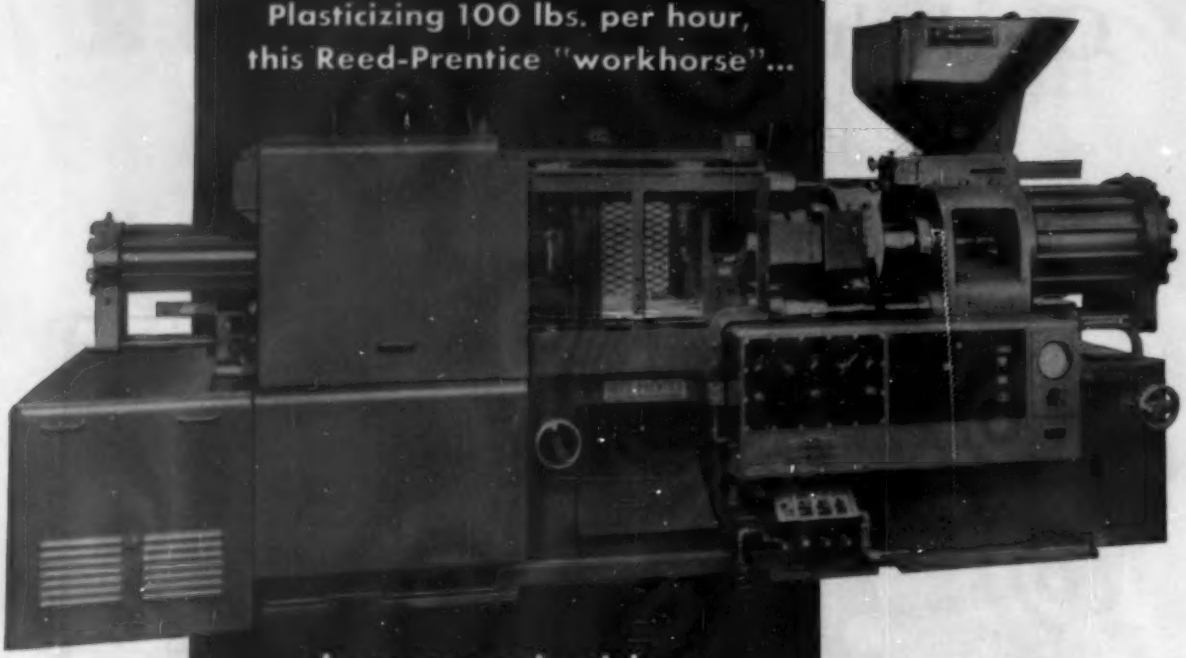
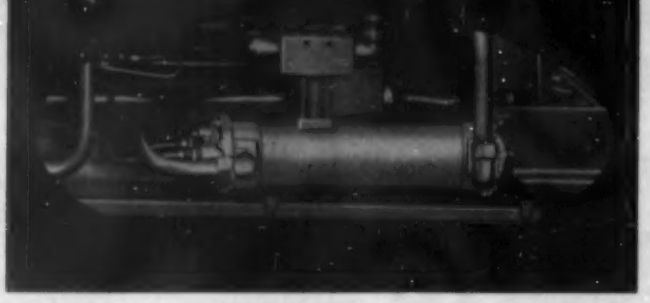


keeps cool with a
ROSS EXCHANGER



Designed to develop 275-ton mold closing pressure, this Reed-Prentice 10D-8 oz. Injection Molding Machine is equipped for rapid, continuous production of plastic parts. Hence, its reputation as the "workhorse" of the industry.

To provide continuous cooling of hydraulic oil, a Ross Type BCF Exchanger has been installed. Pump slippage from overheated, thinned oil is effectively prevented. *Rated hydraulic power is thus insured!*

"We specify Ross Exchangers exclusively for our machines because through the years, they have proven their dependability in standing up under continuous operation," states Reed-Prentice Corporation.

With an unequalled job record for ruggedness and thermal efficiency, Ross Exchangers are regularly selected for numerous types and makes of hydraulic machinery: extrusion and metal drawing presses, die casting machines, powdered metal presses, injection and compression molding machines.

Pre-engineered and fully standardized, all copper and copper alloy Ross Type BCF Exchangers are stocked in a wide range of sizes to meet most requirements ... *promptly.*

For detailed information, request Bulletin 1.1K5.

ROSS

EXCHANGERS

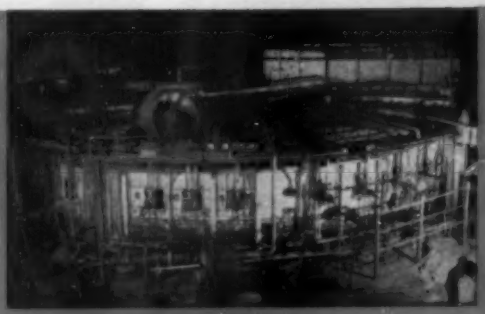
KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

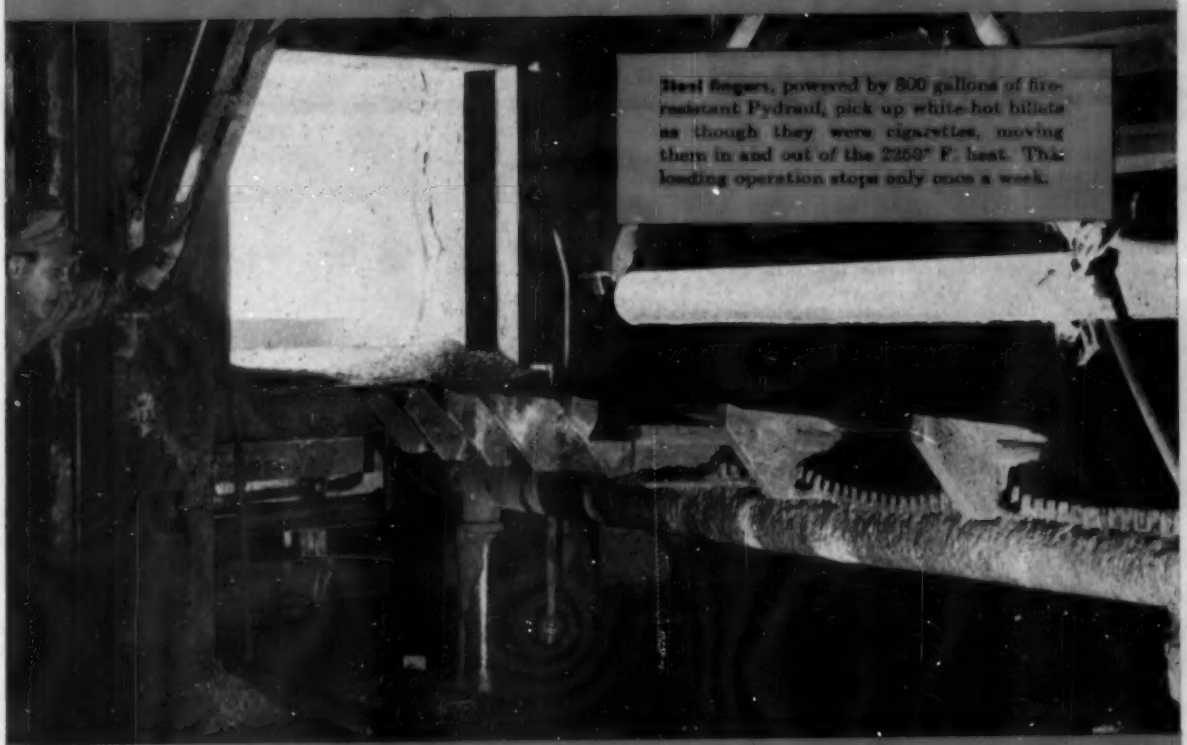
1464 WEST AVENUE • BUFFALO 13, N. Y.

In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS



One line break with flammable fluid, causing a costly shutdown, moved Spang-Chalfant to switch to Monsanto Pydraul. Long-lasting and noncorrosive, Pydraul reduces make-up rates by as much as 80%.



Steel fingers, powered by 800 gallons of fire-resistant Pydraul, pick up white-hot billets as though they were cigarettes, moving them in and out of the 2250° F. heat. This loading operation stops only once a week.

PYDRAUL STOPS FIRES BEFORE THEY START

Monsanto Hydraulic Fluid Helps Steel Furnace Operate 160 Hours a Week

OPERATING CONTINUOUSLY to keep up with production schedules, this Hagan Rotary furnace at the Spang-Chalfant plant of The National Supply Company is equipped with a hydraulic loading boom actuated by fire-resistant Pydraul F-9.

BEFORE PYDRAUL F-9 was adopted, a line containing flammable fluid broke—shutting the furnace down for six hours. In addition to damage to electrical connections, the downtime was expensive in terms of lost production.

AFTER PYDRAUL WAS INTRODUCED, one incident demonstrated dramatically its fire-resistant properties. A ruptured hose connection sprayed Pydraul over hot billets and into the furnace door. This time, however, there was no damage to equipment or injury to personnel. Only a minimum of production time was lost while the hydraulic system was refilled.

Pydraul—Reg. U. S. Pat. Off.

Ask us for this booklet on Pydraul. Write Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Box 478, St. Louis 1, Missouri.

MONSANTO
CHEMICALS—PLASTICS

USEFUL LITERATURE

You'll find many valuable production and design ideas in publications described here . . . copies will be sent you free without obligation

AIR AND HYDRAULIC MAINTENANCE MANUAL . . . with the title "The ABC's on Maintenance of Air and Hydraulic Equipment", has been released by Logansport Machine Co. Inc. The pocket-size booklet deals with this subject in cartoon style. The booklet gives you an explanation of the "rights" and "wrongs" in setting up and servicing air and hydraulic equipment.

Circle 200 on Reader Service Card

PISTON RINGS . . . for every purpose are described and cataloged in a booklet available from The Auto-Diesel Piston Ring Co. The various standard ring styles are illustrated and the purpose of each is briefly explained. Descriptions are also given of bronze, and stainless steel piston rings, plunger rings and guide rings. Many sizes of rings are shown from 1 in to 35 in dia. Included are the widths and wall thicknesses for each diameter.

Circle 201 on Reader Service Card

SILICONE RUBBER . . . To help the user select the Silastic best suited to his needs, Dow Corning Corp. has compiled a reference guide to 30 of the most popular stocks and pastes. Identified as Technical Data 9-334, it briefly describes each new stock, giving its leading characteristics, useful temperature range, suggested applications and recommended fabrication methods. Also listed are the typical properties of finished parts, fabricated and cured, as recommended for each of these 30 stocks and pastes. Included are specific gravity, tensile strength, percent elongation and resistance to compression set.

Circle 202 on Reader Service Card

AIR AND HYDRAULIC CYLINDERS . . . Many of the features of the standard Lindberg Engineering Co. line of the 150 psi maximum air pressure air cylinders and the 1500 and 3000 psi hydraulic cylinders are presented in Bulletin 800. Many of the mountings available are illustrated. A 16 page bulletin 732 gives more detailed information and dimensional drawings of the air cylinders. A 28 page bulletin 702 gives further information on the hydraulic cylinders.

Circle 203 on Reader Service Card

HYDRAULIC MOTOR . . . A very complete resume as to description, specifications and operation are given in Bulletin A-5205, released by Vickers, Inc. A cross-sectional view shows the construction of the constant displacement piston motor designed for 3000 psi service. The motors are designed to convert a continuous flow of hydraulic oil under pressure to rotary mechanical motion. The offset position of the cylinder block with respect to the drive shaft causes the pistons to traverse their respective cylinder bores. As a piston moves away from one valve plate under pressure, the opposite bottomed piston moves toward the valve plate exhausting spent hydraulic oil. The nine pistons perform the same operation in succession, so that the acceptance of oil under pressure is continuous and the conversion to rotary motion is smooth.

Circle 204 on Reader Service Card

PRICE LIST FOR STOCK CYLINDERS . . . A comprehensive price list covering its complete line of stock cylinders for immediate delivery is now available from Miller Fluid Power Co. The list permits fast, easy pricing of 540 individual cylinders in interchangeable mountings, including air cylinders from 2 in through 8 in bores; hydraulic cylinders from 1-½ in through 4 in bores, and both cushioned and non-cushioned types. Strokes range from 2 in through 13 in. The price list also contains line drawings that show how the interchangeable mountings can be assembled to obtain up to 8 different models from one basic model.

Circle 205 on Reader Service Card

For more reviews of Free Literature turn to page 120

Circle 42 on Reader Service Card

SAFEGUARDING INDUSTRY'S *Lifelines of Mobile Power*

190 HORSEPOWER "led to work" through

Eastman

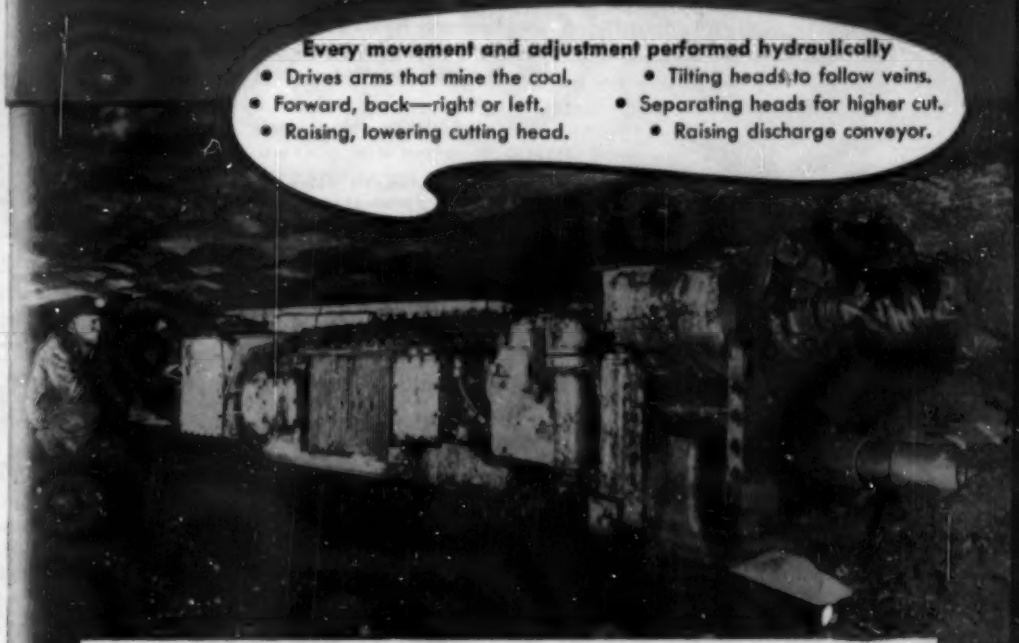
first in the field

HYDRAULIC HOSE ASSEMBLIES

enables the Jeffrey COLMOL to mine 3 to 5 tons of coal per minute

Every movement and adjustment performed hydraulically

- Drives arms that mine the coal.
- Forward, back—right or left.
- Raising, lowering cutting head.
- Tilting heads to follow veins.
- Separating heads for higher cut.
- Raising discharge conveyor.



The mechanical marvel shown in operation here . . . the 76-B Jeffrey COLMOL . . . is indeed a "mighty mole," capable of tunneling into a coal vein at a speed of two feet, or more, per minute—delivering from 50 to 100 tons of coal per man day.

Every movement and adjustment is hydraulically controlled through Eastman Hydraulic Hose Assemblies. Over 2000 psi is applied through 1¼" Eastman double braided hose, delivering 140 hp to 10 coal cutters which rotate at 50 rpm against the coal seam. Another 50 hp is independently provided for other hydraulic operations. Marvelous mobility is evidenced by the fact that this 25 foot, 35 ton monster can turn around in its own length.

The Jeffrey Mfg. Co., pioneers in the coal mining equipment field, have used Eastman Hydraulic Hose Assemblies on all their machines for over 20 years. Eastman Manufacturing Company, pioneer in its own field, too—is proud to have played a part in the development of the Jeffrey line.

Call upon our 25 years of experience in the application of mobile hydraulic power . . . for greater efficiency in power transmission, lowest cost power delivery and most satisfactory performance. Engineering consultation at your call.

specify

Eastman

first in the field

HYDRAULIC HOSE ASSEMBLIES

for the best performance, for long life and satisfaction—*all along the line*—from manufacturer to user. Check your needs on the following list:

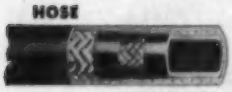
COUPLINGS

Solid Male

Swivel Male

Swivel Female

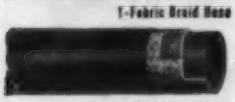
HOSE



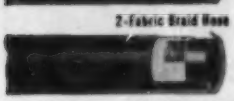
1-Wire Braid Hose

2-Wire Braid Hose

1-Fabric Braid Hose



2-Fabric Braid Hose



Spiral Wire Hose

Write

for free catalog 101 on Eastman hose couplings and fittings.

Eastman

MANUFACTURING COMPANY

Since 1914

Dept. AH-7, Manitowoc, Wisconsin

NEW PRODUCTS

Components, tools and equipment designed to improve operation of fluid power systems are described here . . . for more information fill in and mail the post card bound in this issue.

MAGNETIC SEPARATOR
. . . for hydraulic systems

Designation: Model PX-2
Design: Designed specifically for use in aircraft hydraulic circuits but may be installed wherever working pressures do not exceed 3000 psi. The fluid enters

from either end and is filtered through a stack of soft steel grids which are strongly magnetized by Alnico permanent magnets.
Specifications: Has a maximum capacity of 10 gpm. Hydraulic "O" ring gaskets provide positive seal at both ends.
Applications: For hydraulic fluid systems. It provides for the removal of very fine steel particles that may wear off moving parts.

S. G. Frantz Co., Inc.,
Trenton, New Jersey
Circle 150 on Reader Service Card

3-WAY PILOT VALVES
. . . manually operated

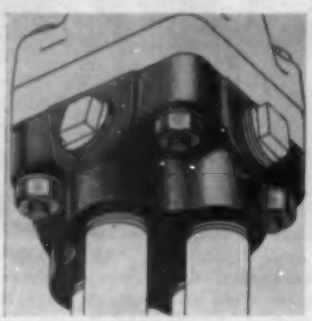
Operation: These valves come in five models operated by lever,

roller cam, stud and palm buttons, each model is available normally closed or normally open.
Applications: Small, aluminum construction and are used at standard pressures for controlling flow of compressed air. They are also available for low pressure hydraulic operation. Manually operated pilot valves for the operation of single acting or spring return cylinders and for operating large master valves.

Automatic Valve Co.,
Farmington, Mich.
Circle 151 on Reader Service Card

SUB-BASE
. . . for 4-way valve

Size: ½ in
Application: Ideal for produc-

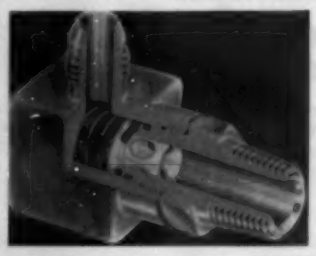


tion line installations where maintenance down time is costly. Valve replacement can be made in a matter of minutes by simply removing four bolts, the piping remains undisturbed. All four lines may be brought up from the bottom, from four sides or in combination.

Barksdale Valves,
Los Angeles 58, Cal.
Circle 152 on Reader Service Card

RIGHT ANGLE CHECK VALVE
. . . simplifies installation

Designation: P-602
Features: The configuration of the right angle check valve has been developed to answer the

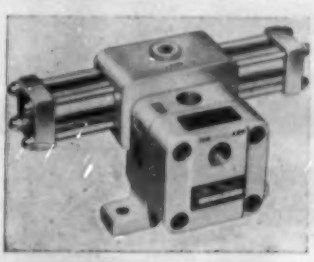


need for a valve having all of the characteristics of their standard inline 200 series, but which must fit into a system in a limited space. The same design principles used in other circle seal valves have been applied. The right angle design will frequently simplify line arrangement and facilitate installation.

James-Pond-Clark,
Pasadena 8, Cal.
Circle 153 on Reader Service Card

POWER OPERATED VALVES
. . . actuate cylinders automatically

Sizes: From ⅜ in to 1¼ in std pipe connections
Features: Available in two and



three position. Free-floating piston movement, completely elim-

Continued on page 16

MORE AND MORE MANUFACTURERS ARE INSTALLING
MARVEL SYNCLINAL FILTERS
AS STANDARD EQUIPMENT

Manufacturers of hydraulically actuated equipment and others with low pressure liquid circulating systems demand their equipment to perform consistently and with all the productive efficiency they build into the machine that bears their name. Since these systems must be kept free of damaging particles, the selection of a filter is an important factor. Here are some of the outstanding reasons for the increasing preference for Marvel Synclinal Filters to do this all-important job!

SUMP TYPE
(Cutaway)

BECAUSE . . . Marvels are designed to give maximum ACTIVE filtering area rather than total filtering area. Only *ACTIVE* FILTERING AREA COUNTS!

BECAUSE . . . Marvels greater storage space for filtered out particles allows longer periods of "production" time at absolute minimum in maintenance cost and "down-time".

BECAUSE . . . Marvels can be disassembled, cleaned and reassembled by any workman in a matter of minutes. Line type operates efficiently in any position and may be serviced without disturbing pipe connections.

BECAUSE . . . Marvels are protected and of sound construction to give long life and efficient filtration.

BECAUSE . . . Marvels (Both Sump and Line Type) are available in individual capacities from 5 to 100 G.P.M. and choice of mesh sizes ranging from coarse 30 to fine 200, they get a filter to fit their specific requirements.

BECAUSE . . . Marvel not only delivers a top grade filter in both quality and performance, but delivers IMMEDIATELY —shipments are made the same day orders are received, if desired.

LINE TYPE
(Cutaway)

FACTS — NOT CLAIMS

Engineers decide on the basis of the record, on the basis of measurable facts rather than claims of the "campaign promise" variety. Here is a fact with meaning:

OVER 400 MANUFACTURERS MAKE MARVEL SYNCLINAL FILTERS THEIR O.E.M. CHOICE

For Dependable Protection On All Hydraulic And Low Pressure Systems Investigate MARVEL SYNCLINAL FILTERS

WATER FILTERS

In response to the great demand, we have adapted both our sump and line models for use in all water filtering applications. No changes have been made in the basic synclinal design.

MARVEL *Engineering Company*

625 WEST JACKSON BLVD., CHICAGO 6, ILLINOIS
Phone Franklin 2-4431

COUPON

Marvel Engineering Company AH-7
625 W. Jackson Blvd., Chicago 6, Ill.
Without obligation, please send me complete engineering data on Marvel Synclinal Filters as follows—
Catalog #106 for Oil Filters
Catalog #300 for Water Filters

Name .....
Company .....
Address .....
City ..... State .....

FLEX-O-TUBE®

When you specify Flex-O-Tube for flexible lines you get the utmost in *dependability* as well as *bendability*.

Manufacturing facilities are keyed to precise production control. This means you can depend on Flex-O-Tube delivery dates . . . and that's mighty important when you're working against tight production schedules.

Every needed inspection and testing facility is on hand at Flex-O-Tube to safeguard the high quality standards of every product shipped. You can depend on Flex-O-Tube performance.

Dependable, too, is the engineering counsel we gladly extend when you're developing new flexible hose products. This engineering know-how is based on more than twenty years in the business.

If there's a flexible line in your product to conduct air or liquid, that has to be bendable, call in Flex-O-Tube . . . it's dependable.

Supplied in Assemblies

Flex-O-Tube will help you determine the assembly needed or work to your own specifications. In either case, modern facilities and latest inspection techniques assure you a uniformly high quality product delivered promptly.

Supplied for Field Assembly

Flex-O-Tube hose is also supplied in bulk coils with reusable fittings for field assembly. Complete range of sizes and types.

Please send me your free ☐ aircraft catalog. ☐ industrial catalog.

Name .....

Company .....

City ..... Zone ..... State .....

Address .....

FLEX-O-TUBE

DIVISION OF MERIDAN CORP.

764 FOURTEENTH • DETROIT 16, MICHIGAN

Flex-O-Tube Co. (Canada), Ltd., Windsor, Ontario

New Products

Continued

inating alignment problems; floating piston bar, insuring fast and dependable action; use of pilot valves, permitting numerous and interchangeable control combinations; power return to all positions, eliminating the use of springs; use of non-corrosive materials, allowing operation by air, gas, oil or water; long life, running into millions of cycles; completely accessible for ease of inspection. Fast cycling, few moving parts and minimum maintenance.

Ledeen Manufacturing Co., Los Angeles 15, Cal.

Circle 154 on Reader Service Card

QUICK-LOCKING COUPLINGS . . . for air systems

Designation: 1800 Series

Design: Meets the requirements of MIL-C-4109A and has been

tested and proven for performance under the most severe conditions of heat, cold, vibration, rough service and high pressures far exceeding those required for air-operated tools and equipment. Interchangeable with connectors of most leading manufacturers, thus making an equipment changeover practical.

Construction: Incorporates a "quick-lock" principle (one-quarter turn) which makes split second interchange of tools.

Applications: Air tools, air hose, air brake systems, paint spray equipment.

Roytyn Incorporated, Glendale 1, Cal.

Circle 155 on Reader Service Card

SILICONE RUBBER "O" RINGS . . . are Kel-F coated

Specifications: The useful tem-

Continued on page 18

FREE USEFUL LITERATURE

Pressure Switch Selection Chart provides an easy method of finding a pressure switch for your specific application. This tabulation helps you define your requirements and saves you time in finding the correct switch for your job.

Check number M3 on the coupon below.

Piston Pressure Switch bulletin describes in detail the entire service range from 15 to 3000 P.S.I. (7000 P.S.I. proof pressure). Belongs on Production Equipment, where millions of cycles are expected, and on Original Equipment, where flexibility and price are a factor.

Check number 9612 on the coupon below.

Variable Actuation Valve Switch is outlined in this bulletin. They are bourdon tube switches with proof pressures to 12,000 P.S.I.

Check number 314 on coupon below.

The "Shear-Seal" principle is a revolutionary twentieth century advancement in valving extreme pressures as well as low pressures and vacuum. The only known method to achieve leakproof closure and maintain or improve sealing qualities with use. This patented principle is illustrated and discussed in a comprehensive bulletin.

Check number BV-2 on the coupon below.

Solenoid "Shear-Seal" Valve Catalog gives complete information on line of shut-off, diverter, 3-way and 4-way selector and 3 position selector valves for Air, Water and Oil Service to 3000 P.S.I.

Check number 1B-2 on coupon below.

Solenoid Air Valves, the famous Crescent 3-way and 4-way valves, are catalogued with complete technical description in this eight-page brochure. Where long service without valve maintenance or solenoid trouble is essential, these valves have become standard.

Check number 3C-1 on the coupon below.

New 20-page catalog includes all basic information on Barksdale Manual Shear-Seal valves, Solenoid Shear-Seal valves, Meletron Pressure Switches, and Crescent Air Valves.

Check number 3G on coupon below.

Barksdale Valves

5125 Alcoa Ave. L.A. 58, Calif.

M3 ☐ 9612 ☐ 314 ☐ BV-2 ☐

1B-2 ☐ 3C-1 ☐ 3G ☐

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

A TIGHT SEAL WITH A BALANCED LOAD

The simple rugged design of "Shear-Seal" valves pays off in an unbelievably *long service life free from maintenance* of any kind.

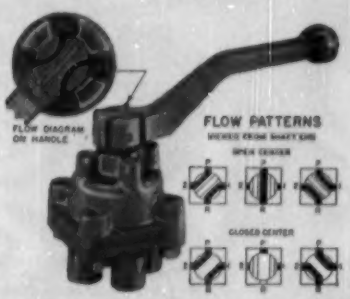
The *leakproof* closure of the self aligning, self cleaning valving members actually improves with the lapping action of each operation; they wear-in, where others wear-out.

They are not put out of commission by dirt or erosion (wire drawing), because *flow is through, never across, sealing members.*

"Shear-Seal" valves provide excellent *throttling* action, *never freeze up*, and *without lubrication* or constant servicing of any kind.

The 4-way selector valve for 1500 p.s.i. oil service, illustrated below, has been developed with particular consideration of the *Original Equipment Manufacturer.*

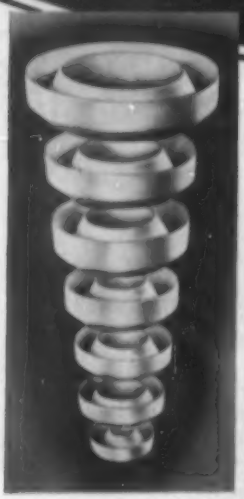
Worthwhile savings, in first and after costs, are passed on through *latest manufacturing methods*, through design features with unusual *versatility* in mounting and piping arrangement, through an unmatched *trouble-free service life.*



BARKSDALE VALVES

5125 Alcoa Avenue, Los Angeles 58, Calif.

"JOHN CRANE"
TEFLON*
"C-V" rings

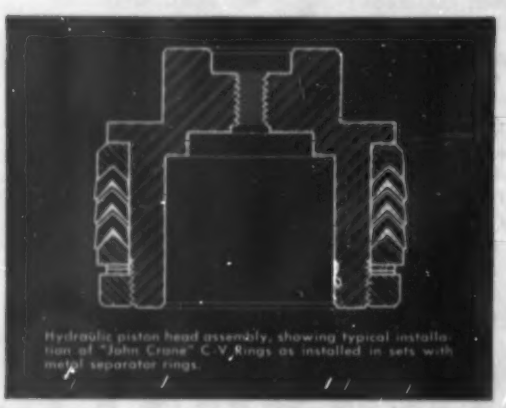


First preference
in hydraulic service
everywhere!
because...

Teflon "C-V" Rings withstand
1. Temperature from —94° to +482°F.
2. Any type hydraulic fluid

Why repack with ordinary materials when corrosively inert "John Crane" Teflon "C-V" Rings will effectively seal any hydraulic fluid, including the newly developed synthetics, and resist high temperatures as well. Also, they have extremely low friction characteristics—will not shrink, swell, harden, dissolve, corrode or deteriorate. Ideal for use on hydraulic cylinders, valve stems, reciprocating, centrifugal and rotary pump applications. Cross-section design allows effective sealing at finger-tight gland pressure.

"John Crane" has developed a complete line of standard size Teflon "C-V" Rings and male and female adapter rings to meet practically every need. If you have special requirements, "John Crane" can mold additional sizes to fit your stuffing box requirements.



Hydraulic piston head assembly, showing typical installation of "John Crane" C-V Rings as installed in sets with metal separator rings.

Send for complete information, including this illustrated technical booklet, "The Best in Teflon."
Crane Packing Co., 1805 Cuyler Ave., Chicago 13, Ill.
In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

*Du Pont trademark

JOHN CRANE
CRANE PACKING COMPANY

New Products

Continued

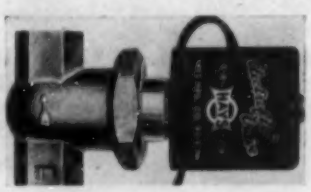
perature range of Kel-F coated silicone rubber "O" rings is approximately —120 F to +390 F. Prolonged exposure of over 390 F is not recommended. Though the chemical resistance of the ring is increased by the Kel-F coating, there is no sacrifice in the low temperature properties of the silicone rubber.

Applications: Particularly useful where resistance is needed to aromatic, chlorinated or other solvents that normally attack silicone rubber.

Bacon Industries, Inc., Watertown, Mass.
Circle 156 on Reader Service Card

AUTOMATIC FLOW CONTROL . . . with solenoid valve

Size: ⅜, ¾, 1¼ in pipe
Features: Provides automatic "on and off" control of flow (water or air), a new piston type, pilot action solenoid operated valve of modern design. Pilot action provides large capacity, has "anti-water hammer" feature. Valve built of non-corrosive parts and is packless in construction. Permits flow only during required periods.



Hays Manufacturing Company, Erie, Pa.
Circle 157 on Reader Service Card

AIR CONTROL VALVE . . . solenoid pilot operated

Designation: Speed King
Sizes: Pipe sizes from ¼ in through 1 in
Features: Designed to meet the standards set by J.I.C. All parts are totally enclosed. The junction box for electrical control is cast integral with the housing of the pilot control unit. The pilot can be mounted in two directions over the base and is universal to

Continued on page 22

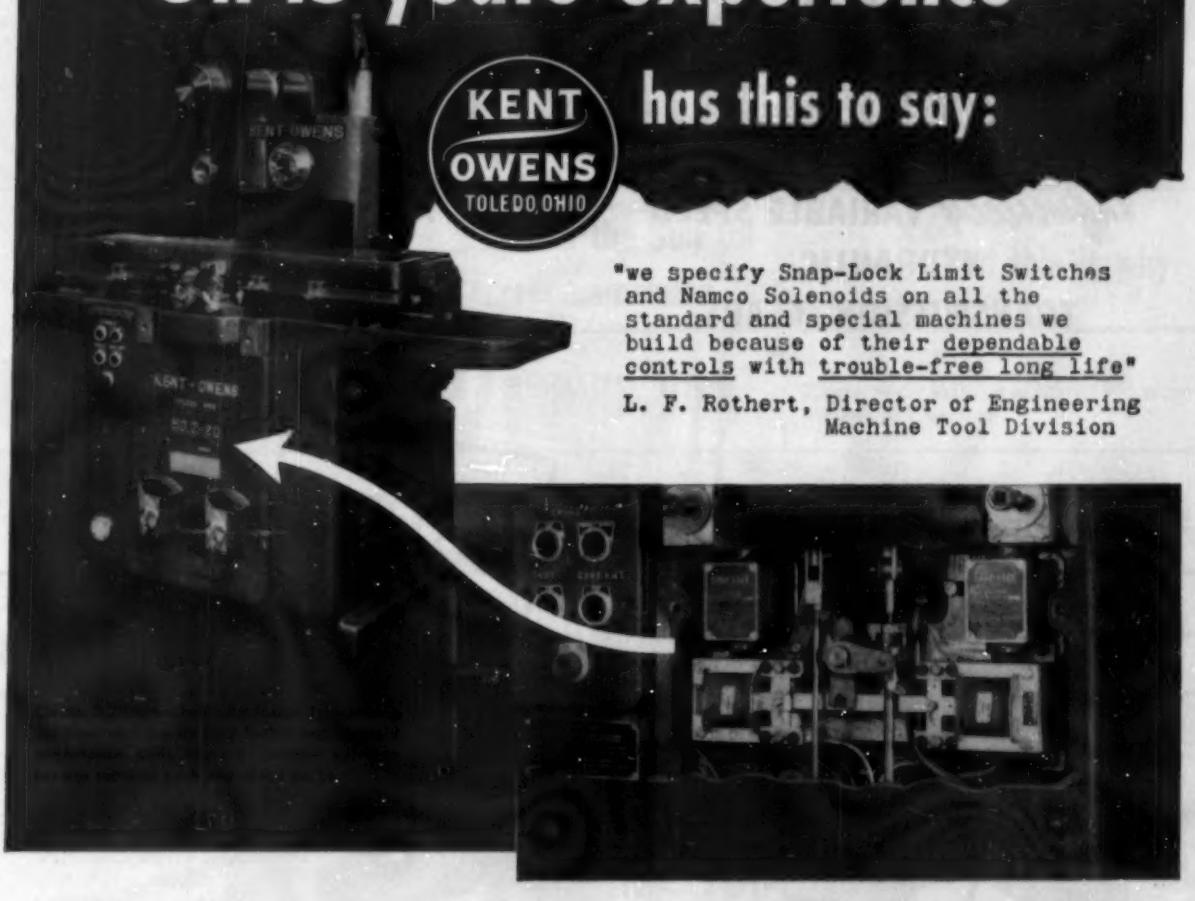
On 15 years experience—

KENT OWENS TOLEDO, OHIO

has this to say:

"we specify Snap-Lock Limit Switches and Namco Solenoids on all the standard and special machines we build because of their dependable controls with trouble-free long life"

L. F. Rothert, Director of Engineering
Machine Tool Division



NOTHING determines the efficiency of your production equipment, and the ultimate cost of its product, so much as the often hidden but vital controls that insure its split second precision, and elimination of down-time losses.

That's exactly the function and the guarantee behind Snap-Lock Switches, designed with separate sealed off mechanical sides, and of Namco "Stellite"-Weld Solenoids. Each is a patented product.

Built first to improve controls—"built with machine tool ruggedness"—for our own Acme-Gridley Automatics, these electrical devices are now specified as standard equipment by 90% of this country's machine tool builders alone. Army, Navy and Aircraft suppliers specify them used singly and in combination. Other uses in valves, clutches, switches and innumerable devices, number in thousands.

If you need to step up a cycle of operation—get rid of mechanical wear, save space and insure more dependable, continuous control of your production, ask our Engineers to help you "design one in" to your machine or process. Engineering specification catalogs—Limit Switches EM-51; Solenoid EM-52.

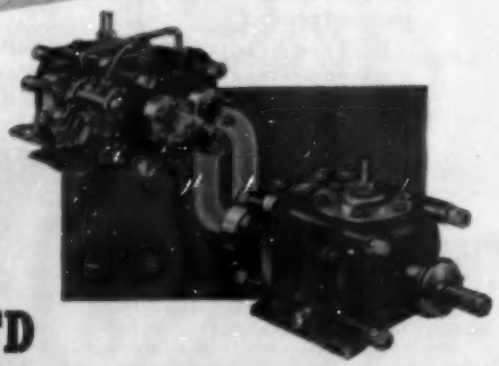
ACME-GRIDLEY
BAR and CHUCKING AUTOMATICS
1-4-6 and 8 Spindle • Hydraulic Thread Rolling Machines • Automatic Threading Dies and Taps • Limit, Motor Starter and Control Station Switches • Solenoids • Contract Manufacturing

The NATIONAL ACME COMPANY
[18]6 EAST 131st STREET • CLEVELAND 8, OHIO

'VSG' *Serving Modern Industry*

Regd Trade Mark

Infinitely VARIABLE SPEED HYDRAULIC TRANSMISSION GEARS



Extensive new plant has recently been installed in Sheffield, England, by Firth Vickers and Samuel Fox. The above illustrations show one of the Pickling and Annealing Lines. For precise speed control over a wide range and for accurate synchronisation of each section drive 'VSG' Hydraulic Transmission Gears were selected.

VICKERS-ARMSTRONGS LTD

VICKERS HOUSE BROADWAY LONDON SWI ENGLAND Cables VICASTRONG LONDON

D16c

SAVE BY SWITCHING TO SUN HYDRAULIC OILS

If your system is in this condition	This is the Sun Oil recommended	And this is why
TIGHT SYSTEM. System never changed. Little or no make-up oil added.	**SUNVIS 900**	Exceptionally long life of Sunvis 900 keeps overall costs low.
TIGHT SYSTEM. Changed annually. Make-up oil added when needed.	**SOLNUS**	Solnus is a quality oil with a long life and a moderate price.
LEAKY SYSTEM without dilution. Where make-up averages 5% or more per month.	**SUNTAC**	Suntac cuts oil costs by reducing leakage an average of 35%.
LEAKY SYSTEM with dilution from water, cutting oil, emulsions and other liquids. Frequent change needed.	**CIRCO**	When frequently changed, Circo gives excellent protection at a low price.
DEPOSITS BUILT UP inside system from dust, sludge, varnish or other contaminants. Comparatively tight system.	**SUNVIS H.D. 700**	The cleansing action of Sunvis H.D. 700 removes deposits, eliminates costly tear-downs for cleaning.
DUAL PURPOSE. Machine tools designed so that hydraulic oil also lubricates ways.	**LUBEWAY**	A good hydraulic oil, Lubeway has the film strength needed to protect expensive ways.

No one oil can give greatest economy in *all* hydraulic systems. As this chart points out, the condition of the system must be considered. To make sure that the oil you select will give the maximum economy in your particular system, have a talk with your Sun Oil Company representative. Or write Department AH-7.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

SUNOCO®

PHILADELPHIA 3, PA. • SUN OIL COMPANY LTD., TORONTO & MONTREAL

Refiners of famous High-Test Blue Sunoco Gasoline

NOW

FOR INDUSTRIAL HIGH PRESSURE HYDRAULIC DEMANDS—

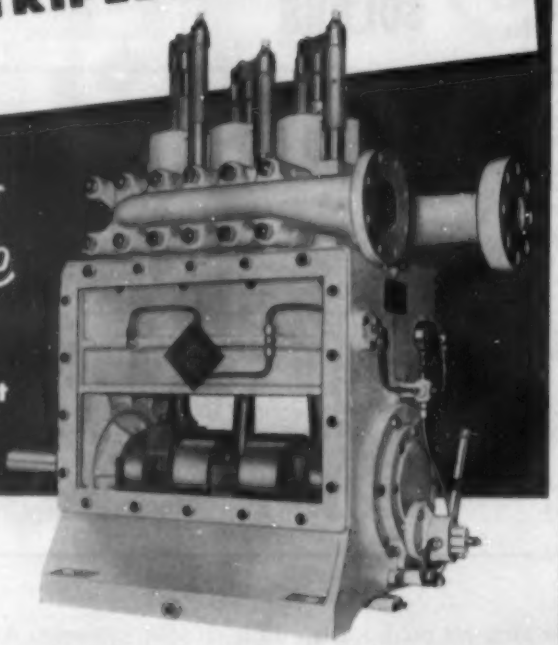
The Field-Proved, Dependable

Ajax

TRIPLEX PUMPS

Better Value

for your investment dollar!



Outstandingly simple in construction and ease of accessibility, the new AJAX TP-4000 and TP-5000 vertical, triplex pumps have every quality feature for continuous industrial usage — field-proved under the most rugged service conditions. Unique pressure lubrication system, factory-adjusted double row main roller bearings, sectionalized fluid end are typical AJAX advantages. Write for complete details.

AJAX IRON WORKS

CORRY, PENNSYLVANIA

New Products

Continued

all assemblies. All parts are noncorrosive. The base is cast bronze; the pilot valve, a zinc base alloy casting.

Specifications: The stem in the

base and plunger in the solenoid are the only moving parts. Pressure range is from 35 to 200 psi for air and low pressure hydraulics. 2-,3-,4-, and 4-way-5-port (2 pressure) models are available.

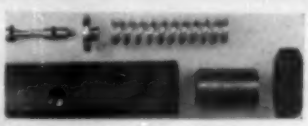
Valvair Corporation, Akron 11, Ohio

Circle 158 on Reader Service Card

GAUGE CUTOUT
. . . for pressures to 3000 psi

Design: Sensitive response is afforded at pressures as low as 10 psi. Additional advantage is to be found in the corrosive resistant, lightweight aluminum body of the cutouts.

Construction: A special low rate spring may be substituted in



either of these two models. In the low pressure gauge cutout, this special spring introduces high operational efficiency at the 10-60 psi range. In the high pressure gauge cutout it is notably accurate for pressure ranges from 100 to 600 psi.

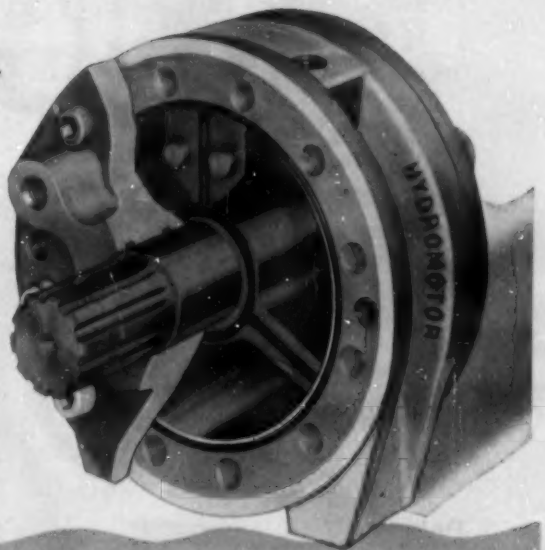
Specifications: Available in two models, a low pressure cutout with ranges from 10 to 300 psi and a high pressure cutout with

Continued on page 24

BONNOT *Hydromotor*

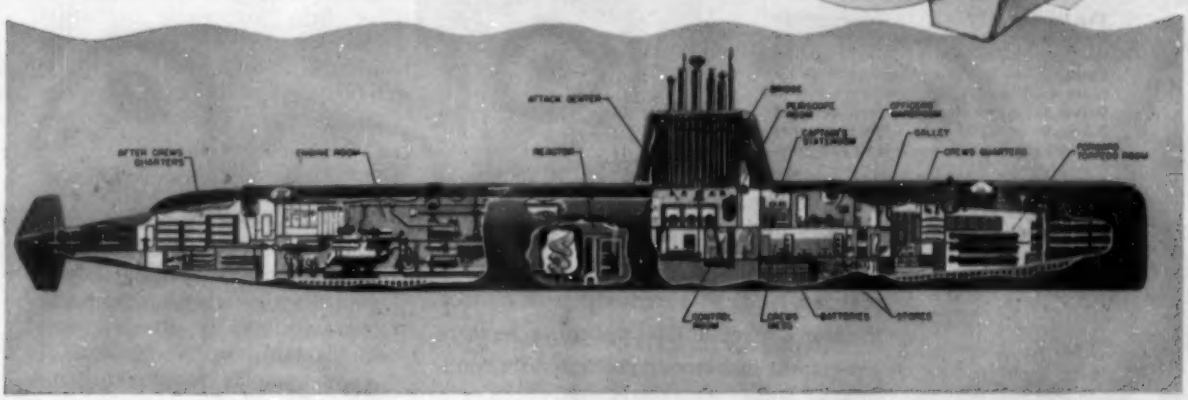
GOES TO THE NATION'S DEFENSE

aboard the *Nautilus*



Aboard the Navy's first atomic-powered submarine Nautilus, the space-saving, weight-saving Bonnot **Hydromotor** is efficiently providing RECIPROCATING ROTARY POWER. And in industry, these unique hydraulic actuators are replacing out-moded methods of "precision control, manipulation and movement."

In brief, the versatile Bonnot **Hydromotor** develops instant, full torque in either direction—operates with oil, water or air—may



be installed anywhere, at any angle—is completely sealed and self-contained—may be stopped and reversed at any point.

Simple controls permit an infinite and variable range of speeds at any stroke length up to an arc of 280 degrees. Standard models develop 150 to 300,000 inch-pounds torque. Double vane units (same size) produce double torque—up to 600,000 inch-pounds—through 100 degree travel limit.

Larger and smaller sizes constantly under development or already custom-built.

Let us show YOU how Bonnot Hydromotors can help increase YOUR product efficiency or lower plant operating costs. Write for Bulletin 521 describing applications and engineering details . . . OR SUBMIT DETAILS OF YOUR SPECIFIC NEEDS.

For Lowering • Revolving • Lifting • Pushing
Pulling • Swinging • Opening • Closing • Clamping
Turning • Indexing • Oscillating, etc.

Hydromotor DIVISION

THE BONNOT COMPANY • CANTON 2, OHIO

Back of the JOHN DEERE No. 55 Combine is a story of . . .

Oil Power

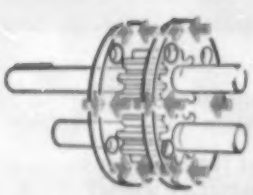
HYDRECO

Oil Power

The famous HYDRECO Four-Bolt design Hydraulic Pump provides Oil Power on the John Deere No. 55 Self-Propelled Combine to position the Auger Platform and control the Variable Speed Drive. This model 1506 Pump delivers 3.3 gpm at 1200 rpm with pressures to 1500 psi... other models to 130 gpm.

Build the hydraulic circuit around the dependability of HYDRECO components. More and more design engineers find this premise leads to successful performance in service whether the application be farm equipment, machine tools, materials handling or construction machinery.

HYDRECO Oil Power . . . Pumps, Motors, Valves and Cylinders have one important characteristic in common . . . they're *dependable*. And the engineering that contributes this dependability may be relied upon to make significant contributions to your present and projected hydraulic problems.



Pressure Balanced wear plates maintain a fixed clearance between wear plates and gear faces regardless of pressure. This feature in HYDRECO Pumps and Motors minimizes oil slippage and power loss... volumetric efficiency and mechanical efficiency remain high!

Write for brochures on HYDRECO Pumps, Motors, Valves and Cylinders.

HYDRECO DIVISION

THE NEW YORK AIR BRAKE COMPANY

1104 EAST 222nd STREET • CLEVELAND 17 • OHIO

New Products

Continued

ranges from 100 to 3000 psi.
Applications: Gives positive protection against excessive line pressures that damage expensive gauges, meters and instruments.

Greer Hydraulics, Inc., Brooklyn, New York

Circle 159 on Reader Service Card

INDEXING TABLES
. . . have positive lock

Designation: Model 725-F
Design: Furnished without control valves (Model 725-FA) and

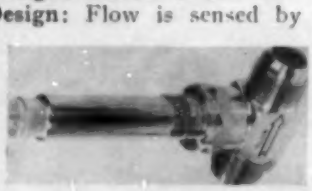
also comes completely equipped for fully automatic operation (Model 725-FB). Both models are available in the standard 4-6-8-12 and 24 set of indexing positions. Accuracy of indexing is guaranteed within ±.002 at the periphery of the top plate.
Features: An important new feature is the availability of compressed air at the top center of the tables, so that air clamps, air collets, or air chucks can be operated from an outside source as the tables are revolving.
Applications: These tables, designed for use in areas where space is limited, have 7-¼ in dia top plate and can be mounted either horizontally or vertically.

The A. K. Allen Company, Brooklyn 22, New York

Circle 160 on Reader Service Card

FLOW TRANSDUCER
. . . senses liquid velocity

Designation: Mark V
Design: Flow is sensed by a



strain sensitive member which supports a body of revolution immersed in the flow stream. Bonded strain gages in a four active arm bridge circuit translate this mechanical force into a proportional electrical output.

Features: Simplicity of operation (no moving parts), maintenance-free ruggedness, and extreme accuracy and sensitivity in a compact, lightweight unit.

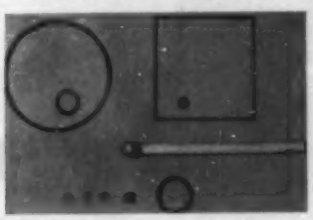
Ramapo Engineering Company, Riverdale, New Jersey

Circle 161 on Reader Service Card

SUB-MINIATURE RUBBER PARTS
. . . have wide applications

Design: Utilization of the injection molding process, is used to produce sub-miniature "O" rings and other microscopic rubber parts with a wide variety of industrial applications.

Applications: Available in sizes as small as .010 in cross-section and .002 in inside diameter. The parts have found applications in



the manufacture of watch cases, butane gas lighters, electronic cables and water injection carburetor nozzles. Additional uses are in small micro switches and miniature air valves and controls.

Minnesota Rubber and Gasket Co, Minneapolis 16, Minn.

Circle 162 on Reader Service Card

DRIP-PROOF, ENCLOSED MOTORS
. . . have new design

Designation: Series 100

Design: Have bearing shields to keep out foreign matter. Space is available for practically any standard bearing. Bearings are locked on the shaft and in the end plate, inside grease caps are a standard feature. Diagonally split terminal boxes provide am-

Continued on page 28

A High Pressure Pump at a Low Pressure Price!

- **COMPLETE HYDRAULIC BALANCE . . . the exclusive DUAL-VANE Design provides and assures complete balance of all hydraulic pressure loads. You get continuous, maintenance-free operation with increased efficiency at all pressures.**
- **INCREASED OUTPUT . . . machine efficiencies can be increased by 2000 psi pump operation without change of other standard components in the hydraulic system.**
- **CARTRIDGE CONSTRUCTION . . . all pumping parts that move are contained within an easy-to-install cartridge. Pump output can be altered by changing cartridge; servicing is simplified and machine down-time reduced.**
- **ECONOMY . . . the low initial cost and the 2000 psi premium performance of DUDCO PF-100 Pumps can double the value of your *hydraulic dollar.***

Write for DUDCO Bulletin No. DP-302. You'll get the facts on the new PF-100 Series Pumps.

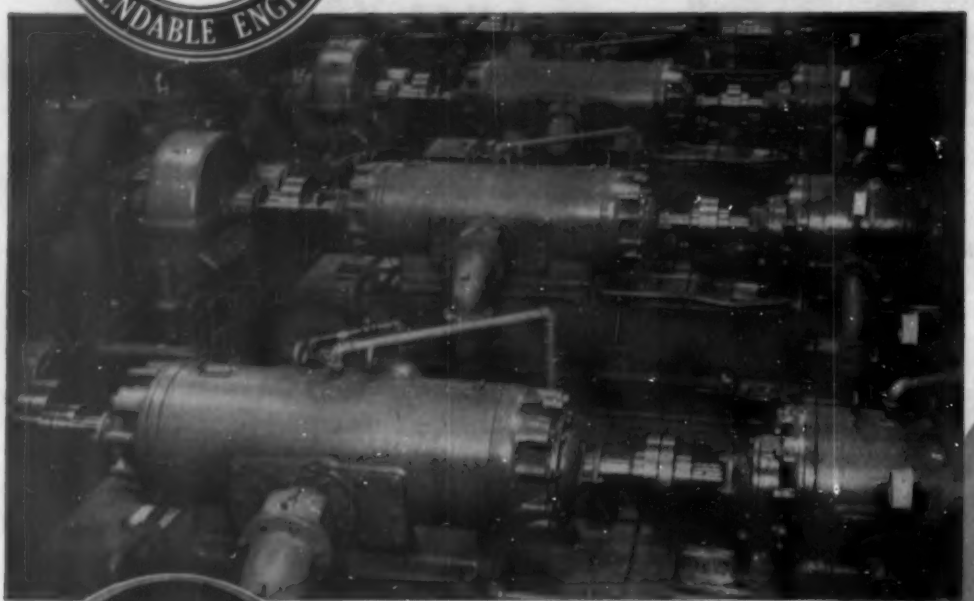
DUDCO DIVISION
THE NEW YORK AIR BRAKE COMPANY
1704 EAST NINE MILE ROAD • HAZEL PARK • MICH.

Circle 39 on Reader Service Card

PRATT & WHITNEY AIRCRAFT

DEPENDABLE ENGINES

PRATT & WHITNEY AIRCRAFT



Four Fuller Rotary Compressors, Elliott steam-turbine driven, have a total capacity of 6760 c.f.m., at 110 p.s.i.

depends on FULLER AIRPOWER

Four Fuller Rotary Two-stage Compressors put Pratt & Whitney Aircraft's engine plant in East Hartford on a 100 p.s.i. air diet for such operations as shot peening, spray booths, air cleaning, and air-operated chucks.

Pratt & Whitney Aircraft has joined no small family of users; food and chemical plants, steel mills and cement mills, gas-gathering plants, refineries, automobile plants, foundries and machine shops, public utilities, and many others depend on Fuller for compressor equipment, wherever air is required.

Whether *your* air-plans call for single-stage, two-stage — single-stage duplex or two-stage duplex—you can be sure Fuller has the compressors which gives you a dependable source of pulsation-free air up to 3300 c.f.m., 125 p.s.i., with maintained capacity for the life of the machine.

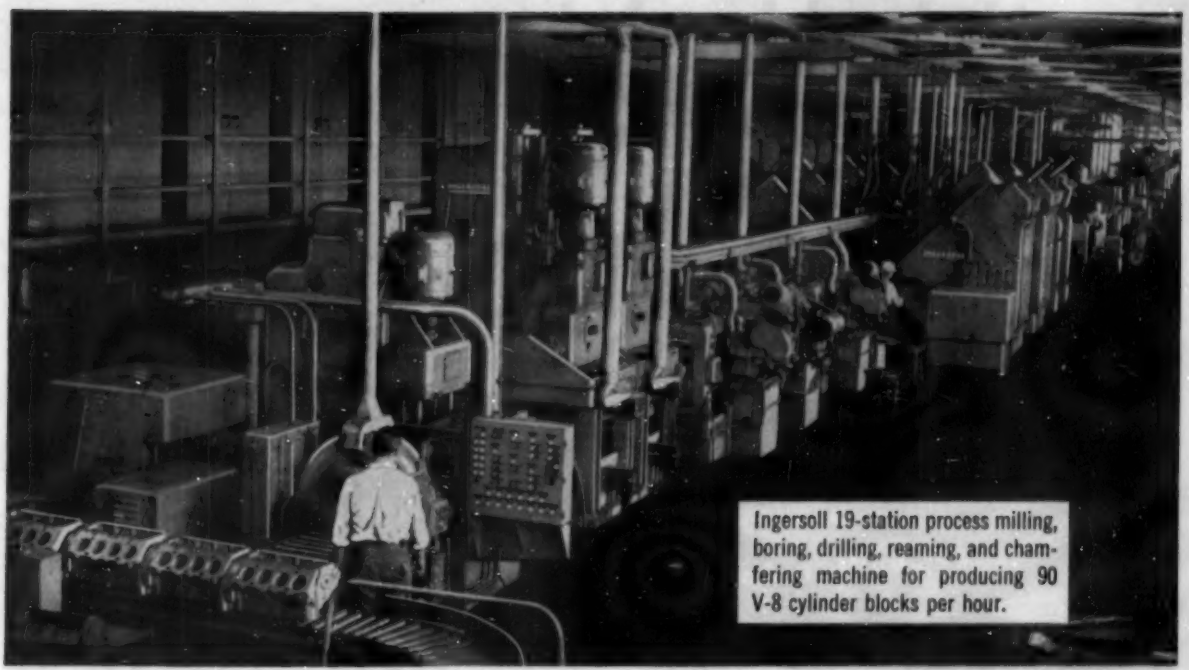
Write for Bulletin C-6, Fuller Rotary Compressors.

FULLER COMPANY, Catasauqua, Pa.
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

Fuller

PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS

C-225
1824



Ingersoll 19-station process milling, boring, drilling, reaming, and chamfering machine for producing 90 V-8 cylinder blocks per hour.

automation at its best uses VICKERS® hydraulics

One operator controls this entire machine in which a total of 20 milling, 18 boring, 16 chamfering and 4 drilling spindles are at work simultaneously. A hydraulic transfer mechanism moves the V-8 engine blocks automatically from station to station . . . turning them as needed . . . clamping and unclamping. Feeding of the tools is also done hydraulically. The entire operation is controlled by electro-hydraulic circuits from the loading station.

Vickers Hydraulics was used throughout by The Ingersoll Milling Machine Company. Among the advantages gained by using Vickers Hydraulics are: (1) simplification of design, (2) flexibility of control, (3) instantaneous response, (4) ease of providing interlocks and overload protection, (5) low maintenance with minimum down time.

The Vickers Application Engineer near you will gladly supply any additional information you may desire regarding the many benefits to be gained by using Vickers Hydraulics.

VICKERS Incorporated

DIVISION OF THE SPERRY CORPORATION

1474 OAKMAN BLVD. • DETROIT 32, MICH.

Application Engineering Offices:

ATLANTA • CHICAGO (Metropolitan) • CINCINNATI • CLEVELAND • DETROIT • HOUSTON • LOS ANGELES (Metropolitan) • NEW YORK (Metropolitan) • PHILADELPHIA (Metropolitan) • PITTSBURGH • ROCHESTER • ROCKFORD SEATTLE • TULSA • WASHINGTON • WORCESTER

Representative Standard VICKERS® Units Used on Ingersoll Transfer Machines

Single Stage Balanced Vane Type Pump

Double and Two-Pressure Balanced Vane Pumps

Power Unit is Self-Contained Power Source

Solenoid Controlled Pilot Operated 4-Way Valve

Traverse and Feed Cycle Control Panel

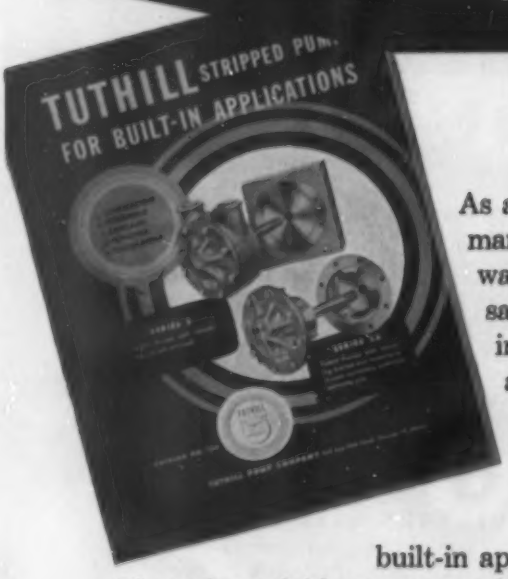
Balanced Piston Type Relief Valve

6684

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

worth looking into...

NOW...a complete new catalog on
TUTHILL STRIPPED PUMPS
for Built-in Applications



As a practical help to manufacturers who want to reduce cost, save space, and improve product appearance, Tuthill now offers Catalog No. 106 on Stripped Pumps for built-in applications.

These dependable pumps are furnished in a wide range of types and sizes for lubrication, hydraulic, coolant and liquid transfer service...in capacities from ⅓ to 200 g.p.m. and pressures to 200 p.s.i.

Write for your copy of Catalog No. 106 today.

TUTHILL
PUMP COMPANY

TUTHILL PUMPS FOR THE PURPOSE

Dependable Rotary Pumps since 1927
939 East 95th Street, Chicago 19, Illinois
Canadian Affiliate: Ingersoll Machine & Tool Co., Ltd.
Ingersoll, Ontario, Canada

New Products

Continued

ple space for connections. All operating characteristics are equal to or improved over present motors. Temperature rise within 40 C rating is readily maintained.

Specifications: The first motors offered are (1) open, drip-proof motors, and (2) totally enclosed, fan-cooled. Both types are available in 182 and 184 frame sizes, rated at 1, 1½ and 2 hp at 1800 rpm; 1½, 2 and 3 hp at 3600 rpm; and ¾, 1, 1½ hp at 1200 rpm.

Howell Electric Motors Company, Howell, Mich.
Circle 163 on Reader Service Card

OIL SEAL
. . . protects bearings

Designation: National Triple-Lip Syntech
Design: Unit employs three identical sealing lips of synthetic

rubber, bonded to steel washers and enclosed in a rigid steel outer case. Use of these thin synthetic sealing lips keeps seal torque low, simplifies flush lubrication and enables the seal to handle large amounts of shaft runout and misalignment.

National Motor Bearing Co., Inc., Redwood City, Cal.
Circle 164 on Reader Service Card

For more NEW PRODUCT reviews turn to page 92

AEROQUIP HOSE LINES with Detachable, Reusable Fittings

Solve Design Problems

Extreme heat, cold, vibration, installation complexities, and other fluid line problems can be solved readily by the application of Aeroquip flexible hose lines. A variety of hose line types in a wide range of sizes and burst pressures meet every industrial need.

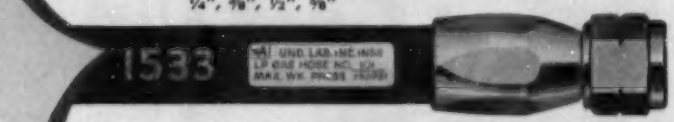
Aeroquip hose assemblies can be made right in your plant, *in minutes*, by cutting bulk hose to length and attaching the reusable fittings. An inventory of bulk stock permits the making of individual hose lines for mock up installations or thousands of hose lines for production runs.

Write for complete hose line information. If you want help on a specific problem, a qualified Aeroquip sales engineer will arrange a call.

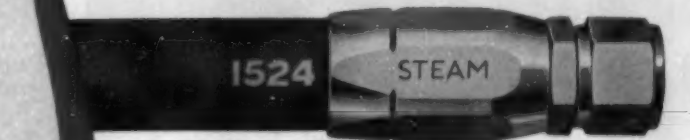
Aeroquip double wire braid hose for high pressure hydraulic, hot oil, grease, crude and fuel oil, gasoline, and air lines. Pressures range from 5000 p.s.i. in ¼" size to 1000 p.s.i. in 2" size.

Aeroquip 1500 p.s.i. single wire braid hose for medium pressure hydraulic, water, hot oil, crude and fuel oil, anti-freeze solution, gasoline, diesel fuel, and air lines. ¼" to ¾".

Aeroquip 250 p.s.i. triple-ply cotton-reinforced hose with one-piece SOCKETLESS fittings for low pressure hydraulic, water, hot oil, crude and fuel oil, anti-freeze solution, gasoline, diesel fuel, vacuum and air lines. ¼", ⅜", ½", ⅝"



Aeroquip wire-braid-reinforced butane-propane hose for LPG engine plumbing or for fixed installations where vibration causes problems. This is the only butane-propane hose line listed by the underwriters' laboratories. ¼" to 2".



Aeroquip burstproof hose with *"little gem"* fittings for steam cleaning units, dry cleaning and pressing equipment, foundry equipment, plastic molding presses, steam boiler installations, rubber curing and vulcanizing equipment. ½" to 1".

Aeroquip Freon hose for use on automotive and commercial air conditioning units and refrigeration equipment using Freon 12. Sizes are ¼" to 2".

"little gem" is an Aeroquip Trademark

Aeroquip

REG TRADE MARK

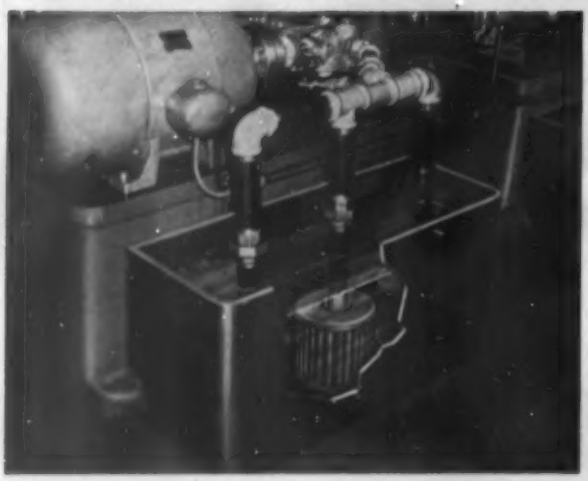
AEROQUIP CORPORATION, JACKSON, MICHIGAN

SALES OFFICES: Burbank, Calif. • Dayton, Ohio • Hagerstown, Md. • High Point, N. C. • Miami Springs, Fla. • Minneapolis, Minn. • Portland, Ore. • Van Wert, Ohio • Wichita, Kan.
IN CANADA: Prenco Progress and Engineering Corporation Ltd., Toronto • **IN ENGLAND:** Super Oil Seals & Gaskets, Ltd., Birmingham

AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

SAVE 3 WAYS

WITH STAYNEW HYDRAULIC FILTERS ON YOUR EQUIPMENT



1. SAVE WEAR ON COSTLY EQUIPMENT
2. SAVE SPOILAGE AND REJECTS AT POINT OF USE
3. SAVE MAN HOURS WASTED IN EQUIPMENT REPAIRS AND MAINTENANCE

Illustration shows method of securing desired capacity in relatively long and narrow tank by means of multiple hook-up.

Staynew's Radial Fin, compact, rigid construction permits the largest possible active filtering area in the smallest space. For example with 14.3 sq. ft. of active filtering area in a 12″ x 12″ Staynew Radial Fin Insert, back pressure is reduced to a minimum, long operation is assured without cleaning or replacement.

For top performance and economical operation, specify Staynew Filters as original equipment on your hydraulically operated machinery. All types of metallic mesh and fabric media are available.

Our Engineering Department will welcome the opportunity of recommending the type of Staynew Filter best suited for your specific need. Write today for Bulletin HF-2.

Representatives in Principal Cities

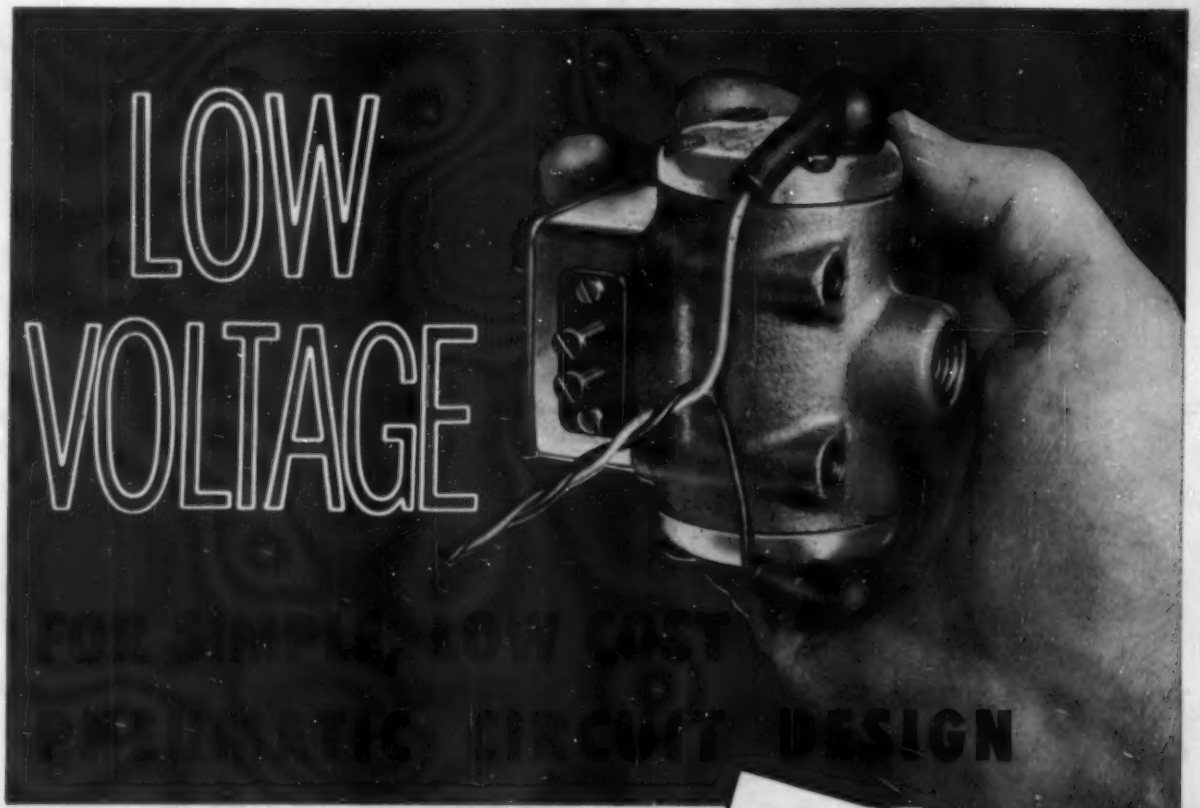
MODEL H
Hydraulic Filter

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

DOLLINGER CORPORATION

65 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED



The Bellows Electroaire* Valve offers design engineers a simple, low cost way of providing positive electrical interlock of pneumatic circuits.

This unique 4-way directional valve is air-powered but electrically controlled. The incoming high pressure air does the actual work of shifting the valve. Two built-in sealed solenoid control units act as "triggers" to release and direct the air pressure. The solenoid units operate on a momentary impulse of 8 volts.

The result: an air control valve so compact that it fits in the palm of a hand; so complete, it incorporates within itself slide valve, solenoid controls, and twin speed controls; so safe it can be wired-up with ordinary bell wire without electrical hazard of any kind.

IS IT FAST?
Faster than the speed ability of any present day air cylinder.

POSITIVE?
It is self-adjusting to any air pressure from 5 to 150 lbs.

DURABLE?
The solenoid control units are guaranteed against burnout. Service records of 30,000,000, 40,000,000, even 50,000,000 cycles are not uncommon.

The Bellows Electroaire Valve is made in ¼", ⅜", and ½" port sizes in both standard and explosion-proof types. It can be adapted for direct connection to, or remote control of any standard air cylinder of suitable capacity. It is a built-in feature of all Bellows "Controlled-Air-Power" Devices arranged for electrical control.

Write for these

[redacted]

Wiring diagrams, technical data, case histories, etc., on the Bellows Electroaire Valve, Bellows Air Motors, and other Bellows pneumatic equipment. Ask for Bulletins AV-300 and CL-50. Address Dept. AH 754, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., 4972 Dundas Street, West, Toronto 18, Canada.

*Patent Pending. TM Reg.

TTP-A

Controlled-Air-Power
FOR FASTER, SAFER, BETTER PRODUCTION

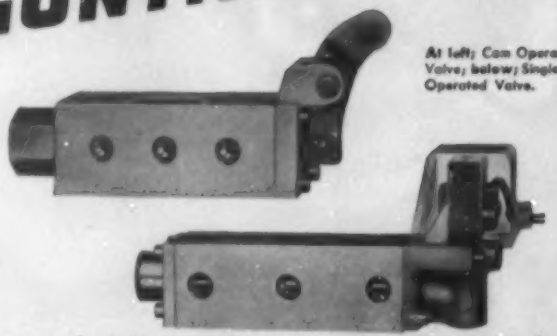
The Bellows Co.

SELECT

Quick-As-Wink

AIR AND HYDRAULIC

CONTROL VALVES



At left: Cam Operated Type "O" Valve; below: Single Solenoid Pilot Operated Valve.

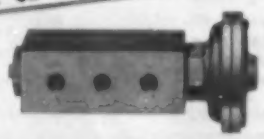
They're designed to give you the fast dependable trouble-free action you need

for single or sequence machine movements

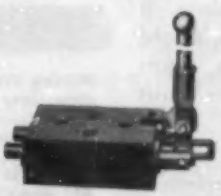
• Those successive and inter-related machine operations — that speed manufacture and cut costs — can only be as successful as the air and hydraulic valves that control the operations. Specify Quick-As-Wink Control Valves.

Positive and fast acting, Quick-As-Wink valves are designed and built to meet the most exacting requirements. They will deliver dependable and precision performance month after month, and year after year. Many superintendents and foremen have found that there is nothing better than a Quick-As-Wink valve. Can you afford to gamble with less? Get full details. Write for Bulletin No. 531 today!

Ask us also about . . .



DIAPHRAGM OPERATED "O-TYPE" VALVE, diaphragm can be actuated with instrument air as low as 12 to 15 psi.

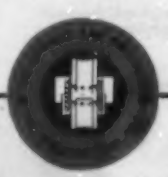


LEVER OPERATED HYDRAULIC VALVE suited for water or hydraulic oils up to 5000 psi. 2-way, 3-way and 4-way actions.

Quick-As-Wink

AIR AND HYDRAULIC

Control Valves



Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1997 East Pershing St., Salem, Ohio

LETTERS to the Editor

Self-Priming, Low Pressure Pump

We would like to obtain a rotary pump for 12 gpm service, capable of self-priming at 5 psia, maximum working delivery pressure of 35 psig. The materials should be of aluminum, stainless steel or synthetics. We would appreciate your advising us of a source that fabricates a pump of this type.

EDWARD BLACKMAN,
Project Engineer
Aircraft Equipment Div.
Consolidated Diesel Electric Corp.

Our first suggestion, Mr. Blackman, would be a positive displacement pump such as the bronze gear pump made by Oberdorfer Foundries, Inc., 3007 Thompson Road, Syracuse, N. Y. We believe this pump would do the job if bronze were acceptable for your application. Otherwise, as far as we know, it would probably be necessary to have a special pump built.

Reprints

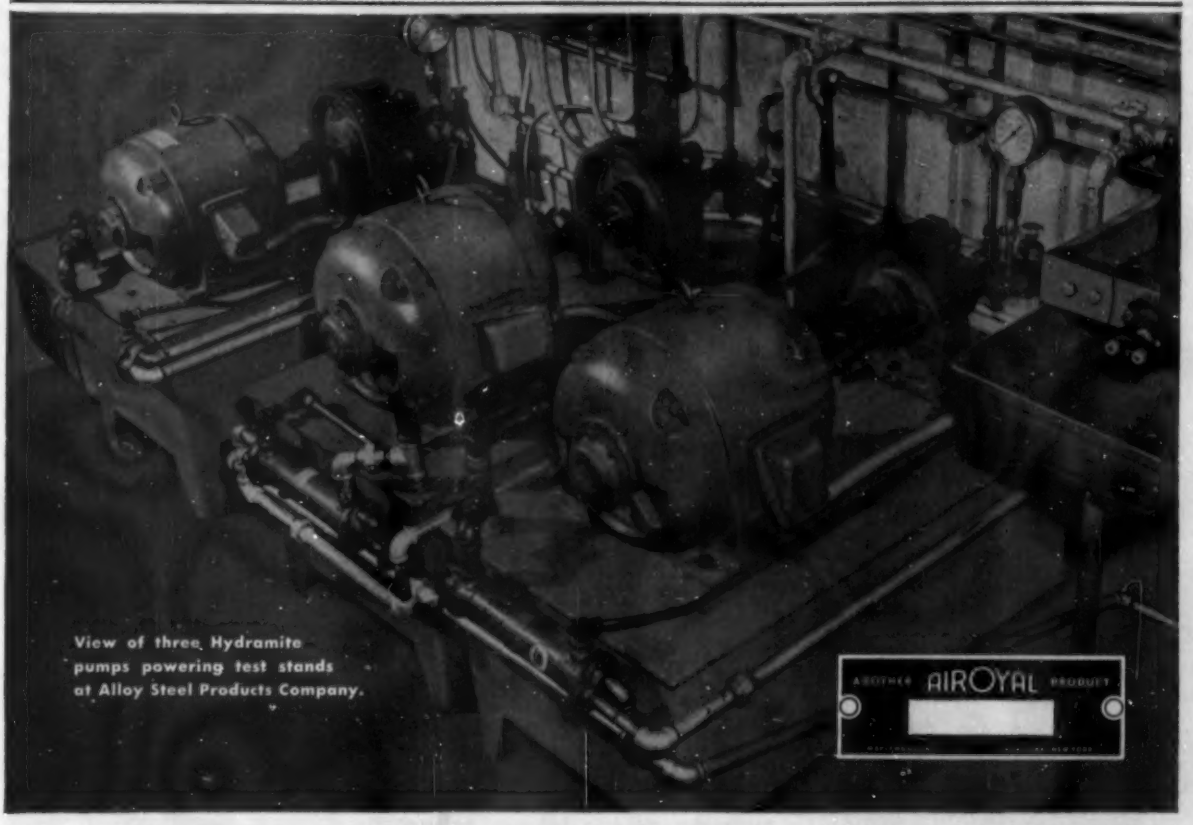
Would you send reprints or tear sheets, one copy each, of the following: "Beginners Course in Basic Hydraulics", "Beginners Course in Basic Pneumatics" and "Servomechanisms for Industry."

I. JEFIMOW,
New York City

The "Beginners Course in Basic Hydraulics" was not republished. The "Beginners Course in Basic Pneumatics", the last installment of which ran in the June, 1954 issue, will be republished in booklet form. It is expected that this will be ready for distribution in late summer or early fall. We will announce in APPLIED HYDRAULICS when the booklet will be ready. "Servomechanisms for Industry" has been re-

Continued on page 34

WHEN IT'S HIGH PRESSURE, IT'S **AMERICAN!**



View of three Hydramite pumps powering test stands at Alloy Steel Products Company.

AE representative provides "muscle" for valve testing

ALLOY STEEL PRODUCTS COMPANY, Linden, N. J., makers of stainless steel valves, recently needed new hydraulic units for use in hydrostatic tests. They called on The Airoyal Company who designed and produced three units employing AE Hydramite fluid power generators which actuate cylinders that clamp the valves in place while being tested. The installation has speeded up testing operations and has proved 100% reliable.

The Hydramite has rapidly become the first choice for a widespread range of hydraulically-operated equipment... and always provides the efficiency and economy associated with products of the American Engineering Company. Available in a variety of sizes, it develops pressures up to 5000 p.s.i. and operates on most of the makes and viscosities of oil suitable for hydraulic circuits.

No matter what sort of high pressure hydraulic pumping system you need, in most areas there's a nearby AE hydraulic equipment representative to save you time and expense in its engineering and construction. And from then on you can count on him to assume *local* responsibility for continuous efficient service.

Mail coupon for full information about the Hydramite for constant displacement from 3 to 100 g.p.m.; or about the Hele-Shaw for variable displacement from 1 to 110 g.p.m. and pressures to 3000 p.s.i.

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA.
IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD., MONTREAL 2, CANADA

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2530 Aramingo Avenue, Philadelphia 25, Pa.

Gentlemen: Please send me complete information about the ☐ Hydramite. ☐ Hele-Shaw.

Name.....Title.....
Company.....
Address.....
City.....Zone.....State.....

SOLVED

weighing and testing problems by

EMERY force-measuring systems

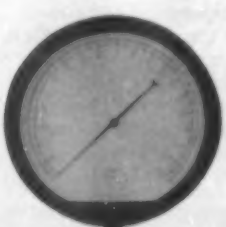
Emery load cells offer the fundamental solution to *any* force-measuring or weighing problem.

Operating on simple, basic physical principles, Emery systems are maintenance-free. Some units have been in service over 25 years without even recalibration!

RANGES: 0 - 10,000,000 pounds . . . **ACCURACY:** 1/10 of 1% of range . . . **RESPONSE:** less than ½ second . . . **TYPES:** self-contained hydraulic, open-flow hydraulic, pneumatic . . . **CELL DEFLECTION:** less than 0.005" . . . **APPLICATIONS:** Weighing, Jet Engine Thrust, Brake Testing, Torque Measurements, Strength of Materials, Process Control, Tank Weighing, Platform Scales, Etc.

Since 1872, Emery Force-Measurement Systems have been lowest in initial cost, in operating cost, and require no maintenance.

Write today for information on stock or specially designed systems to solve your force-measuring problems.



THE A. H. EMERY COMPANY, NEW CANAAN 9, CONN.

Please send me
☐ Literature on hydraulic weighing
☐ Literature on pneumatic weighing

NAME _____

POSITION _____

Attach to, or write on, your company letterhead.

Letters to the Editor

Continued

printed. This reprint ran as three articles in the September, October and November, 1953, issues and is available from Servomechanisms, Inc., 500 Franklin Ave., Garden City, L. I. N. Y.

". . . Air Powered Tooling"

Can you tell us who we should contact for additional information on the article, "Ideas for Reducing Operating Cost of Air Powered Tooling"?

H. L. SCHANSTRA,
Fisher Body Division,
Pontiac Plant,
General Motors Corp.

The data and photographs for this article was furnished us by Mr. William Brotherton, Assistant Manager Public Relations, Ryan Aeronautical Corporation, Lindbergh Field, San Diego, Calif. We suggest you write directly to Mr. Brotherton and detail the information you desire.

Hydraulic Pumping Rig for Oil Wells

I recall having read an article in APPLIED HYDRAULICS on a hydraulic pumping rig for oil wells. I do not find it in my issue file which is not complete. Could you advise which issue included this article?

R. N. BENNETT,
Bennett Engineering Services

We believe the article you have reference to is "Oxidation of Petroleum Base Oils in Hydraulic Power Systems" which was published in the April, 1952, issue of APPLIED HYDRAULICS. The article described a long stroke pumping unit, used for the prime recovery of petroleum, for operation under unusually severe conditions.

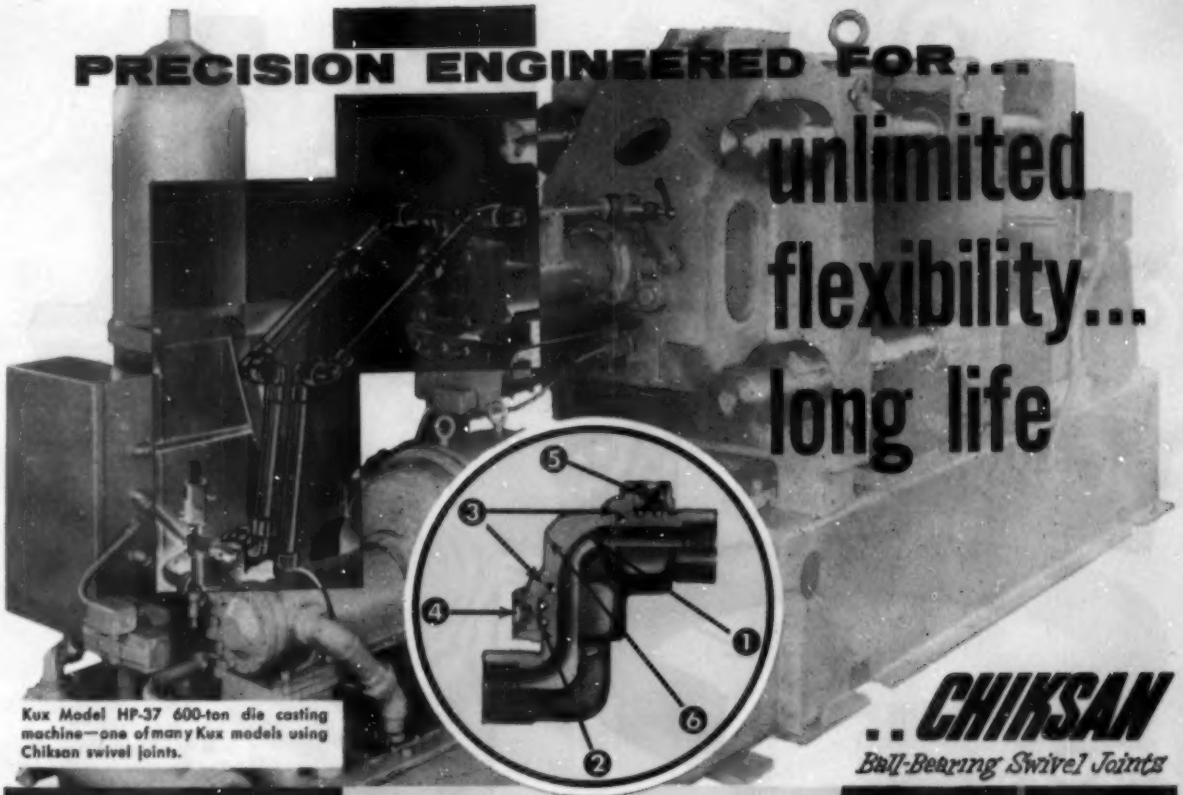
Flow of Hydraulic Fluid in Pipes

Since we furnish with our equipment the hydraulic cylinders and a

Continued on page 38

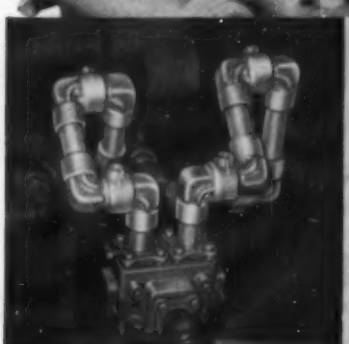
PRECISION ENGINEERED FOR...

unlimited flexibility... long life



Kux Model HP-37 600-ton die casting machine—one of many Kux models using Chiksan swivel joints.

..CHIKSAN
Ball-Bearing Swivel Joints



Johnson Motors cut fluid losses 75%—setting-up time 75% with Chiksan joints on their 48 die-casting machines.

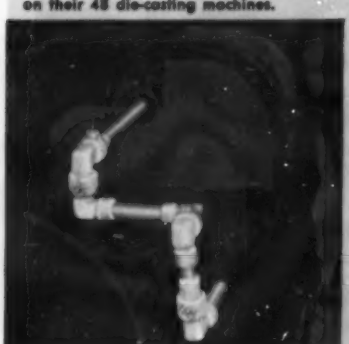
1. Smooth flow radii for minimum flow restriction.
2. 2 rows of ball bearings handle thrust and radial loads.
3. Balanced packing units for specific services.
4. Spherical radius ball plug for uninterrupted ball race.
5. Grease retainer provides extra protection for ball race area.
6. Wall thicknesses provide maximum strength throughout.

CHIKSAN Ball Bearing Swivel Joints turn with full 360° rotation in 1, 2, and 3 planes, handling air, hydraulics, fuels, oils, water and other fluids.

There are over 1,000 different types, styles and sizes for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 75° F. to a plus 500° F. Packing materials have been designed for each specific service.

Wherever unlimited flexibility is required in your research, design and engineering of new equipment for modern industry—CHIKSAN will help you find the solution.

Chiksan swivel joints on fire department trucks provide increased hose flexibility and save on hose wear.



Chiksan high-pressure swivel joints permit compact assembly for operation in limited space on injection molding equipment.

Chiksan high-pressure swivel joints provide flexibility and eliminate danger of ruptured steam lines on platen presses.

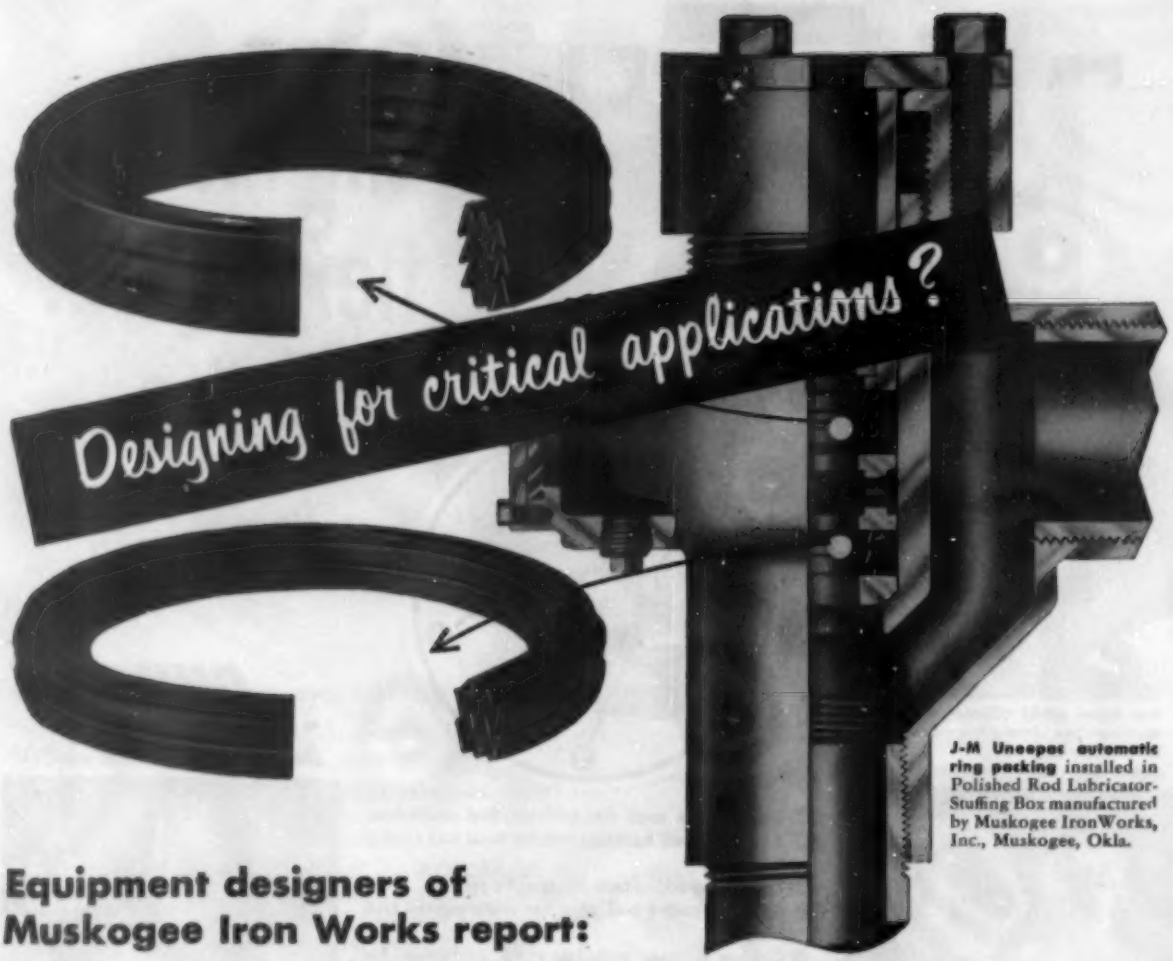
Write for complete information. Dept. 7-AH

The Flow of Enterprise Relies on

CHIKSAN
Ball-Bearing Swivel Joints

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 3, Illinois • Newark 2, New Jersey

Well Equipment Mfg. Corp. Division, Houston 1, Texas • Subsidiaries: Chiksan Export Co., Brea, Calif., Newark 2, N. J. • Chiksan of Canada Ltd., Edmonton, Alta.



J-M Uneepac automatic ring packing installed in Polished Rod Lubricator-Stuffing Box manufactured by Muskogee IronWorks, Inc., Muskogee, Okla.

Equipment designers of Muskogee Iron Works report:

"Greatly increased packing life... Uneepac guards against pressure damage"

FOR THEIR NEW LUBRICATOR-STUFFING BOXES, design engineers of Muskogee Iron Works needed a packing with long service life as well as foolproof operation. Uneepac, the Johns-Manville automatic ring packing, fully met both of these requirements and contributed to the success and acceptance which the equipment has encountered.

In this application, Uneepac protects itself against damage by excessive gland pressure. The lips of each ring are guarded by the projecting portion of the Uneepac Center section. As a result, far greater service life and reliability is obtainable in this application than with other types of packings.

Uneepac offers many other important advantages for use in pump rods and plungers, compressors and similar equipment. Seals effectively in a minimum of space. Operates with minimum friction. Has excellent pressure sensitivity. Uneepac provides trouble-free operation because each ring positions itself diametrically as well as vertically. Header or follower rings are not always required because each Uneepac ring is a complete, self-protected unit.

To learn how Uneepac may aid your new equipment design, too, write for booklet PK-58A. Just address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

Johns-Manville PACKINGS & GASKETS

Circle 70 on Reader Service Card Circle 71 on Reader Service Card

HEAVY DUTY

Hydraulic Cylinders

- **All steel construction—no tie rods, no castings.**
- **Hard chromed and ground piston rod to resist abrasion and prolong seal life.**
- **Self adjusting seals.**
- **Five standard mountings.**
- **Ample rod guide.**
- **Rod wiper seals fitted as standard.**
- **Cushioning at either end or both ends of stroke.**
- **Stroke length to suit your application.**
- **Standard range 2" to 6" bore, double acting.**
- **For working pressures up to 1,500 p.s.i.**
- **Double ended rods available for all standard cylinders.**
- **Special mountings, larger bores and cylinders for higher pressures by arrangement.**

Keelavite *hydraulics*

PUMP/MOTOR UNITS, VALVES, POWER PACKS, TRANSMISSIONS & REMOTE CONTROL SYSTEMS

The recognised Authority on Hydraulic Power Transmission

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Telephone : Meriden 225/6 Telegrams : Keelavite, Coventry

FOR FULLER INFORMATION PIN THIS COUPON TO YOUR LETTERHEADING and post it to KEELAVITE ROTARY PUMPS AND MOTORS LIMITED ALLESLEY COVENTRY England

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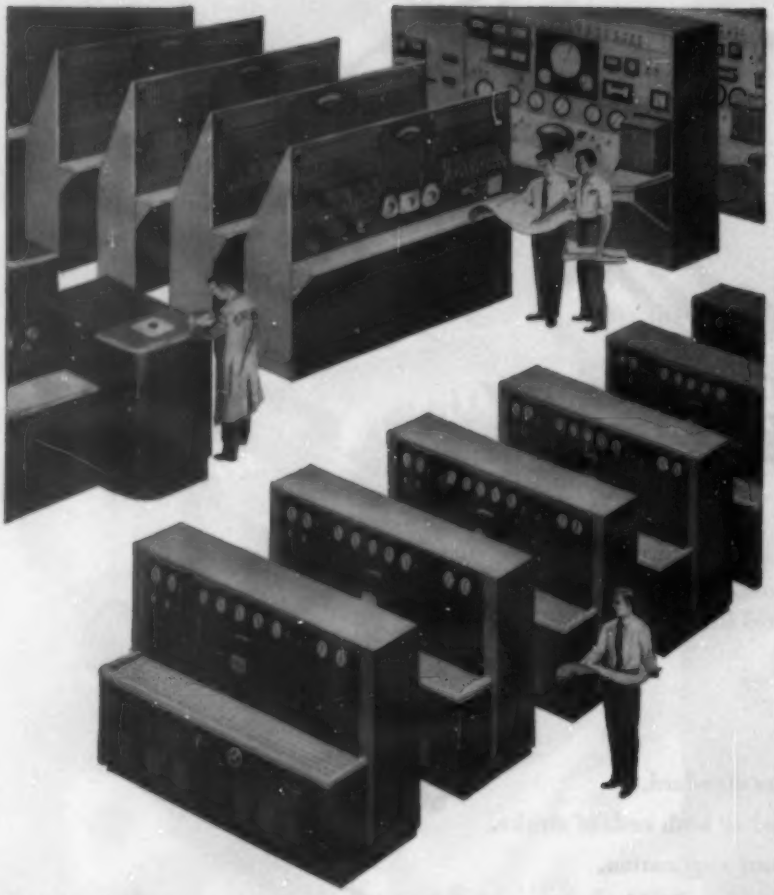


Copied...but never equalled!

GREER
TEST EQUIPMENT

IN THE FIELD of aircraft test equipment, as perhaps in no other, confidence in the maker is all-important. Planes and human lives depend upon the reliability of this vital equipment.

That is why we say, "copied . . . but never equalled." Greer methods of manufacture and inspection are unique. They result in quality control that we believe unequalled in this field. Each part of each machine must pass exhaustive tests before assembly — then the completed equipment is carefully inspected before delivery to customers.

For Greer dependability is not a manufactured component to be drawn to scale and copied. Greer dependability is a result of many years experience of many men, pioneers in this field. It is the reason the most honored names in the aviation industry turn instinctively to Greer to test their products.

We invite you to call on Greer engineers to discuss your testing requirements. Call or write without obligation.

GREER HYDRAULICS INC. • International Airport • JAMAICA 30, NEW YORK

Field offices in Chicago, Dayton and Detroit • Sales Representatives in all principal cities

Letters to the Editor

Continued

standard electric motor driven pump arrangement to create pressure, we are often called upon to size and lay out the piping system from the pressure unit to the cylinders. In many cases this is no small job since there would be as many as 64 cylinders operated from a central unit which might be 200 to 300 feet from the most distant cylinders. Do you have in your files or tell us where we might obtain tables that would give the flow of hydraulic fluid of various viscosities in pipes at pressures from 200 to 400 psi, ie., the carrying capacity of various pipe sizes with different viscosity oils.

HENRY SMITH,
Engineering Department,
Flynn and Emrich Company

A convenient and satisfactory set of tables is published in Bulletins 90010, *Hydraulic Piping and* 90011, *Piping Recommendations, published by the Oilgear Company.*

Hydraulic Fuses

Will you send us whatever information and articles you have on hydraulic fuses and also, manufacturers of this type of valve.

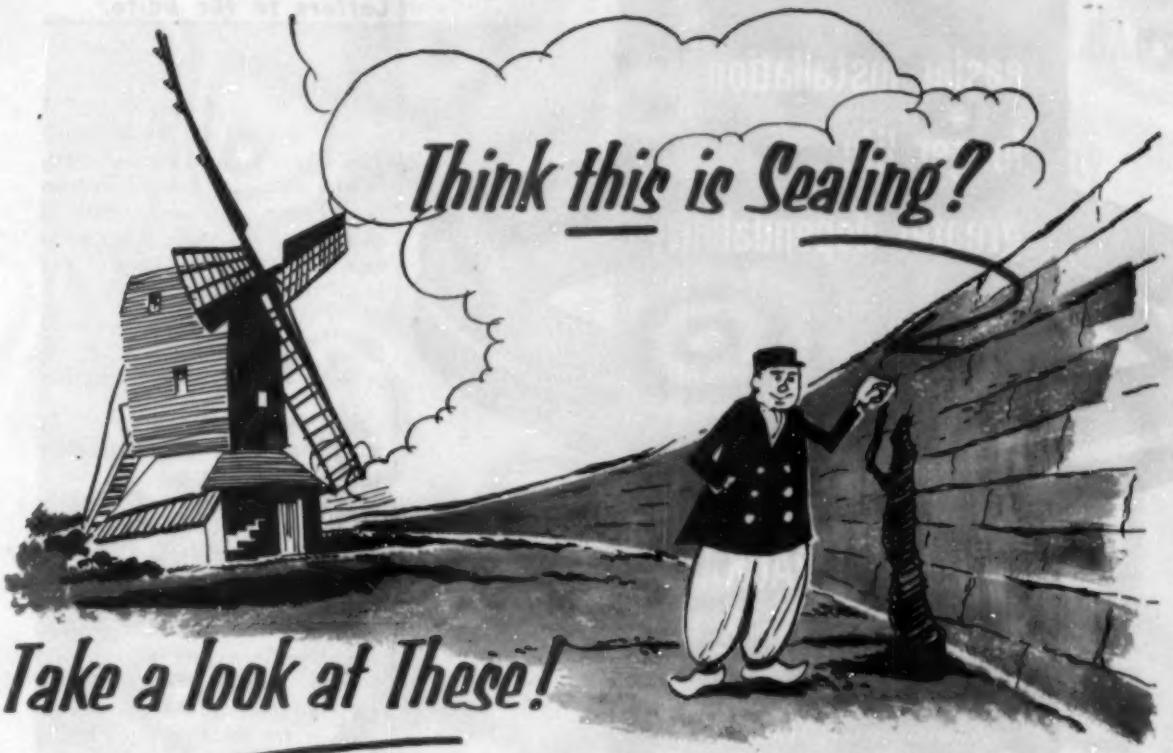
P. KORTENHOVEN,
Supervisor-Mechanical Design,
National Tube Div.
U. S. Steel Corp.

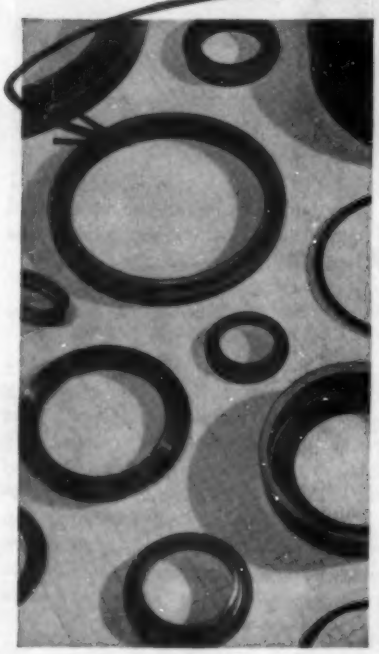
We published an article, "Hydraulic Fuses—What are they?—How do they work"? in the June, 1953, *issue of APPLIED HYDRAULICS. As far as we know the Waterman Engineering Company,* 725 *Custer Ave., Evanston, Ill. is the only source for both Type* 1 (AN6281) *and Type* 2 (AN6282) *parallel flow hydraulic fuses.*

Aniline Point Article

On pages 86, 88 and 90 of the April issue of APPLIED HYDRAULICS you published an article "High

Continued on page 40





When the fabled Dutch Boy stuck his finger in the dike . . . he did a whale of a sealing job. But, when it comes to good seals for hydraulic and pneumatic equipment, *Houghton* has them. Here's how and why!

1. You name the shape and size—we make it.
2. Materials? Rubber, leather, or rubber-impregnated leather are Houghton specialties.
3. We are also manufacturers of Hydraulic Fluids—hence we know how they get along with packings . . . all about compatibility.
4. Houghton's VIM 1243-3 Rubber-Impregnated Leather Packing is the ONLY rubber-impregnated packing that has the sealing capacity of rubber PLUS the anti-friction qualities of leather, is *completely* flexible, and will not cold-flow.
5. We are field-represented by engineer-trained men who can give you all the benefits of our half-century in packings.

Have a packing problem? Call your Houghton Man—he'll be glad to show you sealing power that will solve your packing troubles—for good—no obligation, of course. Or write direct to E. F. Houghton & Co., 303 W. Lehigh Avenue, Phila. 33, Pa.

VIM and VIX-SYN PACKINGS

. . . products of

E. F. HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

easier installation
longer life
greater dependability
with this..
..“PACKING PACKAGE”
Chem-o-green Back-up Rings solve the “O” Ring extrusion problem. Of spiral design, they seek their seat automatically. Require no water soak for installation. Made of duPont TEFLON, they are impervious to all hydrocarbons and synthetic hydraulic fluids. No chemical inspections are needed. They have zero swelling or shrinking as they are non-absorbent. Provide unsurpassed anti-friction properties. Offer a service temperature range from minus 110°F to plus 500°F. and are non-flammable. Also made in solid and split ring types if desired.
U.S.G. “O” Rings are a complete line of homogeneous synthetic rubber packings made in all AN and commercial compounds—and in all standard sizes for “O” Ring packing, gasket and universal tube fitting applications.
Companion Products in “Packing Package”, offered for the obvious advantages of one source and one responsibility for assured satisfaction. Write for Bulletin OR-1152.
UNITED STATES GASKET COMPANY
CAMDEN 1 • NEW JERSEY
FABRICATORS OF duPont TEFLON, Kellogg KEL-F AND OTHER PLASTICS
Representatives in Principal Cities Throughout the World

Letters to the Editor

Continued

and Low Range Aniline Point." I believe this is an article which should have very widespread interest and use throughout the hydraulic industry for manufacturers of all types of equipment using packings. Will you let us know if you intend to reprint this article?

N. A. PEDERSEN,
President,
C. B. Hunt & Son, Inc.

The interest in this article by many suppliers of synthetic rubber packings and users as well as manufacturers has been such that we have reprinted the article, "High and Low Range Aniline Point". Two other manufacturers have also ordered a supply for their sales and engineering staffs and individual requests for copies have come in from many sources. NOTE: We can supply copies of this reprint at fifteen cents each or ten cents each for 100 or more copies.

Source for an Equalizing Valve

In your January issue, under "Fluid Power Circuits", on page 27 you show an equalizing valve. Will you tell us who manufactures this valve?

S. M. JACOBS
Chas. F. Wheelock & Associates
Birmingham, Ala.

To our knowledge, no company manufactures this flow equalizing valve as a standard component. This is a special valve. It is special only because there is no great demand at the present time. The valve design is simple. We are sending you the names of several valve manufacturers who may be willing to work with you to produce the valve for your application.

Machine Designers Manual

I would very much appreciate your recommendations of a book or books on the subject "Practical Applied Industrial Oil Hydraulics" or thereabouts, with accent on the prac-

Continued on page 42

JUST A twist OF THE wrist

That's all it takes to clean the Cuno AUTO-KLEAN—the strainer that can be continuously cleaned while it's working.

Turning the handle one revolution moves the strainer element through comb blades, removing all dirt from strainer surfaces. Dirt particles fall to bottom of housing, where they can be drained off periodically. Cuno's exclusive combing operation cleans thoroughly—without costly interruption of fluid flow.

- AUTO-KLEAN's permanent metal filter element is available in steel, brass or stainless steel for long trouble-free service under any conditions.
- AUTO-KLEAN is adaptable to any fluid-flow system.
- From acids to tar . . . if you can pump it, Cuno can filter it. Capacities range from one gallon per hour to 3,800 gallons per minute.

A.3.8

CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

CUNO'S AUTO-KLEAN ENDS NEED FOR STAND-BY STRAINERS

Permanent strainer element saves on maintenance bills

You don't have to use a duplex strainer installation to get dirt and other solids out of your hydraulic fluids. A *single* Cuno AUTO-KLEAN strainer can do the job to your complete satisfaction.

This is possible because fluid flow doesn't have to stop while you're cleaning this strainer. Cuno's exclusive "comb-clean" action provides complete cleaning of the strainer element on the job—*without stopping fluid flow.* Thus, non-stop filtration, with no need for a stand-by strainer.

AUTO-KLEAN really cuts maintenance bills, for there aren't any cartridges to change. Occasional rotation of the handle does the cleaning job. (Most units can be equipped with motor drives for continuous cleaning.) If you want suction straining, AUTO-KLEAN is ideal. You can build it right into your sump, with the handle on the outside.

AUTO-KLEAN's low pressure drop gives full-flow filtration on gravity, low-pressure, high-pressure or suction lines—with no loss in operating efficiency. All solids larger than the specified disc spacing—from .0035" (170 mesh) to .062" (12 mesh)—are stopped by metal strainer discs. You can get standard AUTO-KLEAN filters built to operate at pressures up to 3000 psi.

Send the coupon today for free bulletin.

A.3.15

Cuno Engineering Corporation
Dept. 3515B South Vine St., Meriden, Conn.

Please send me free bulletin on Cuno AUTO-KLEAN strainers.

Name.....

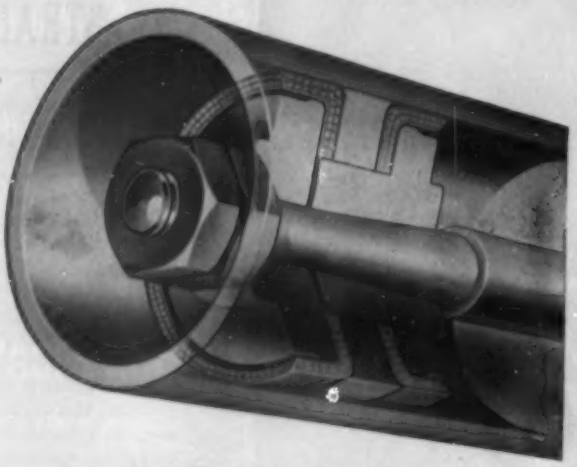
Company.....

Address.....

City.....Zone....State.....

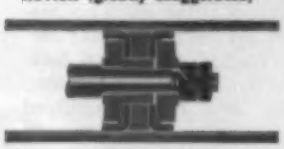
DARCOVA PUMCUPS

more efficient...job after job!



Phantom cutaway showing a typical Pumcup piston assembly.

DIAGRAM OF DARCOVA PUMCUP ACTION (greatly exaggerated)



NORMAL: BOTH PUMCUPS RELAXED

UNDER PRESSURE: PUMCUPS SEAL AGAINST CYLINDER DESPITE WEAR, MINIMIZING SLIPPAGE

NO matter how tough your pumping problem Darcova Pumcups can help solve it . . . this has been proved in thousands of plants year after year.

Darcova Pumcup Advantages

1. Texture engineering that not only increases volumetric efficiency, but keeps it high with no appreciable fluid slippage for the entire life of the Pumcups.

2. Darcova Composition Pumcups give many times the life of other types of piston packing . . . *at least 3 to 1!*

3. Standard or special compositions are available for exceptional stability in handling almost *any* fluid . . . strong acids, alkalies, food products and even troublesome petroleum derivatives.

Send For Free Bulletin—Ask for Bulletin No. 4401 on Pumcups for reciprocating pumps; Bulletin No. 4502 on Pumcups for air and hydraulic mechanisms. Address . . .

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP

PUMCUPS

Letters to the Editor

Continued

tical everyday design usages of hydraulics as opposed to publications which stress theory. We are particularly interested in material which would be useful to equipment or special machinery designers.

T. POBUK,
Supervisor of Equipment Design,
Telechron Department of General Electric Co.

You are asking for a pretty big order, Mr. Pobuk. Such material is still in the heads of experienced designers or in departments of organizations that specialize in the design and building of hydraulically operated machines. However, we have prepared a bibliography, the APPLIED HYDRAULICS Data List, which lists major and leading texts, manuals and technical bulletins of key manufacturers of hydraulic and pneumatic components, circuits and systems. We suggest that you check off two or three of the manuals listed and examine copies. A copy of the Data List has been sent to you. A first suggestion would be Walter Ernst's "Oil Hydraulic Power and Its Industrial Applications".

NOTE: The new 1954 Edition of APPLIED HYDRAULICS Data List has been delayed but copies should be ready in August.

J.I.C. Hydraulic Standards

We are anxious to obtain a copy of the J.I.C. Hydraulic Standards for Industrial Equipment. Also we would like to know the procedure for obtaining MIL and AN specs.

Your assistance will be appreciated.

E. G. LEMAY,
Century Controls Corp.

Copies of J.I.C. Hydraulic Standards for Industrial Equipment may be obtained from Joint Industry Conference, Box 182, Northend Station, Detroit 2, Mich. Copies of MIL, AN and other service specifications may be obtained from the district or local offices of Air Force Procurement, Bureau of Aeronautics, Ordnance or Corps of Engineering.

✓ OFF SHELF DELIVERY!

✓ EXTRA HIGH SAFETY FACTOR!

✓ DEPENDABILITY . . . backed by 38 Years of Know-How!

CIRCULAR HEADS WITH TIE RODS
SQUARE HEADS WITH TIE RODS
T-J
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SPACE SAVED
T-J SPACEMAKER . . . provides additional room for adjacent equipment without sacrificing strength.

NEW T-J

Spacemaker AIR CYLINDERS

Streamlined design of the new T-J Spacemaker *eliminates tie rods . . . saves up to 40 % in mounting space!* It's performance-proved . . . *super rugged* with extra high safety factor . . . solid steel heads . . . heavy wall, precision honed, *hard chrome plated,* seamless steel body . . . leakproof cylinder head to body construction . . . heavy duty, hi-tensile, *hard chrome plated* piston rod.

Available with the new T-J Super Cushion Flexible Seals which insure positive cushion with automatic valve action for fast return stroke. Many standard sizes and styles . . . for pushing, pulling, lifting, clamping or control jobs. T-J dependability. Write for bulletin 454. The Tomkins-Johnson Co., Jackson, Mich.

T-J TOMKINS-JOHNSON

RIVETERS · AIR AND HYDRAULIC CYLINDERS · CUTTERS · CLINCHERS

FOR FULL PROTECTION CHOOSE FROM OUR WIDE SELECTION

Lonergan

SAFETY-RELIEF VALVES

Shown here is our new, exclusive UNI-LINE (41-W-200 series) Valve . . . it has: much higher capacity per size than any other valve; free-acting, self-aligning disc; "floating" guide (readily adjustable for control) which assists in opening and closing action, as well as affording an additional self-aligning feature; Disc and disc holder of forged copper alloy, *not* castings. Available in sizes from 1½" thru 6", Lonergan UNI-LINE Valves offer: reduced cost of discharge piping . . . because of smaller opening required for smaller, (larger capacity) UNI-LINE Valve; less weight, thereby reducing shipping charges; working parts that are easy to replace or re-condition. The new UNI-LINE Bulletin gives full details. LONERGAN has a complete line of hydraulic relief valves for all pressures . . . . may we hear from you as to your particular requirements?

and for ACCURACY YOU CAN DEPEND UPON

Lonergan

PRESSURE GAUGES

Leader of our gauge line is the Lonergan MAXIMON Gauge. This meets the demand for applications requiring highest standards of instrumentation. Lonergan hydraulic gauges (dial scales 0 to 100,000 lbs.) are well known for dependability. Other high quality and production-type gauges are also available. *Get our Bulletin 800-G.*

Lonergan

J. E. LONERGAN COMPANY

Established 1872

218 Race Street—Phila. 6, Pa.

Free Literature Offered in this Month's Ads

For more information circle numbers on the reader service card bound in this issue on page 104.

HOSE LINES with detachable, reusable fittings are described in literature available from Aeroquip Corporation. It is explained, how hose assemblies can be made in your own plant by cutting bulk hose to length, and attaching the reusable fittings.

Circle 3 on Reader Service Card

A catalog is available from Ajax Flexible Coupling Co. Inc., which gives complete information on their rubber-bronze bushed FLEXIBLE COUPLINGS.

Circle 5 on Reader Service Card

Fuller Company ROTARY AIR COMPRESSORS are presented in bulletin C-6. Single-stage, two stage, single-stage duplex and two stage duplex compressors, up to 3300 cfm and 125 psi, are described.

Circle 49 on Reader Service Card

Full information on SMALL CAPACITY PUMPS can be obtained from Gerotor May Corp. These pumps have been redesigned to give more flexibility and range of application.

Circle 54 on Reader Service Card

Catalogs with engineering specifications on LIMIT SWITCHES and SOLENOIDS are available from The National Acme Company. Plant engineers are ready to help you "design one into" your machine or process.

Circle 91 on Reader Service Card

DYNA-SEAL engineering data booklet describes how plug sealing problems are solved. This information on bonded seals is released by Precision Rubber Products Corporation.

Circle 99 on Reader Service Card

Continued on page 47

Circle 82 on Reader Service Card

Circle 112 on Reader Service Card

Here's how you can simplify power transmission with SUNDSTRAND Fluid Motors...

Sundstrand Fluid Motors provide driving power by converting pressurized oil to rotary motion through a simple wobbler—piston arrangement. With one of these motors as a source of power, you can eliminate complicated mechanical-type transmissions, which are highly subject to wear and require considerable maintenance. The fluid motor is compact, it can be mounted close to the driven member. This does away with gears, clutches, belts, chains, and long shafting. Windup, experienced with mechanical-type drives, is no longer a problem. The driven member receives the full force delivered by the high torque motor. Speeds can be controlled infinitely over the complete range without clutching or changing gears.

Sundstrand Fluid Motors are simple in design . . . built to withstand rugged treatment. The shaft and wobbler assembly is the only rotating part. It is dynamically balanced to assure smooth operation and keep maintenance low. Models range in output from 13.65 hp to 30.00 hp at 1000 psi and 1800 rpm. If you have a power transmission problem, a Sundstrand Fluid Motor may be the answer. Write or phone for details. Bulletin 113-2 gives you complete information on application, operation, performance, models, and mounting arrangements of Sundstrand Fluid Motors.

SMALL, COMPACT DESIGN

INFINITE CONTROL OF SPEED

ONLY ONE ROTATING PART

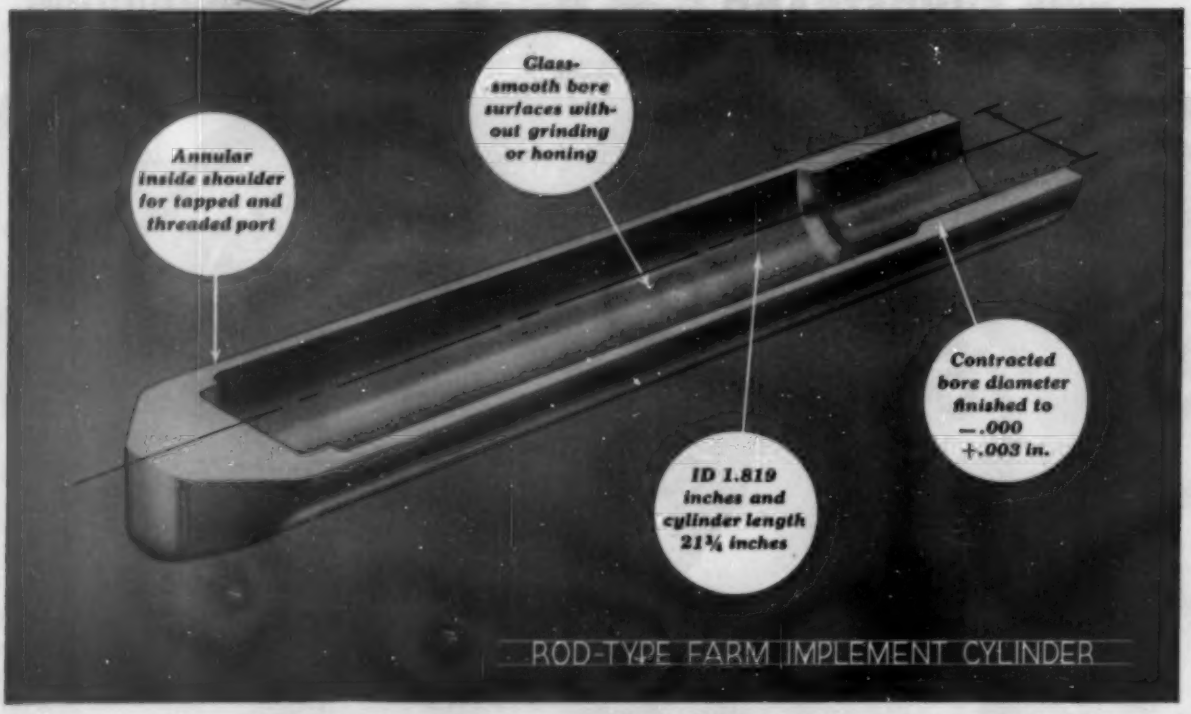
13.65 hp to 30.00 hp

SUNDSTRAND MACHINE TOOL CO.
Industrial Division, Rockford, Illinois

SUNDSTRAND

A name to remember in **INDUSTRIAL HYDRAULICS**

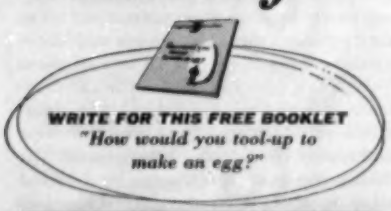
Now Mullins Koldflo makes your dream design practical


Annular inside shoulder for tapped and threaded port
Glass-smooth bore surfaces without grinding or honing
ID 1.819 inches and cylinder length 21¾ inches
Contracted bore diameter finished to —.000 +.003 in.
ROD-TYPE FARM IMPLEMENT CYLINDER

In this rod-type farm implement cylinder — many costly operations can be eliminated...

Mullins *Koldflo* will extrude this finished part in one piece... *without machining*

- ***You can now design intricate steel parts the way you want them — without compromise***
- ***You can add important new sales features***
- ***And Mullins Koldflo design cuts your costs***



WRITE FOR THIS FREE BOOKLET
"How would you tool-up to make an egg?"

MANY of the manufacturing limitations that have plagued creative design engineers are a thing of the past! Now—with the remarkable Mullins *Koldflo* process, you can design intricate steel parts for *one-piece* mass production! A phone call will bring an experienced Mullins *Koldflo* sales engineer to your office—ready to help you design parts that can be mass produced by the Mullins *Koldflo** process! Write for booklet *"How would you tool-up to make an egg?"* *Trade-Mark

DISTRICT SALES ENGINEERING OFFICES

New York	Detroit	Chicago
500 Fifth Avenue	18268 James Couzens Highway	332 South Michigan Avenue
Phone: Pennsylvania 6-2773	Phone: Diamond 1-1490	Phone: Harrison 7-3725

Koldflo
DIVISION
MULLINS MANUFACTURING CORPORATION
Salem, Ohio

Phone — Salem 8771

Free Literature Offered in this Month's Ads

Continued

Literature from Sprague Engineering and Sales Corp., covers complete information on POWER PACKAGES, GAGES and BOOST PUMPS. The power package bulletin is identified as No. 500.

Circle 105 on Reader Service Card

CYLINDER bulletins A-105 and H-104 may be obtained by writing Miller Fluid Power Co. Interesting applications are given in their catalogs including "automation with cylinders".

Circle 87 on Reader Service Card

By writing to Webster Electric for a catalog on HYDRAULIC PUMPS, you will receive performance charts and pump data sheets, on which individual requirements can be submitted.

Circle 126 on Reader Service Card

The engineering department of Dollinger Corporation, will recommend the type filter best suited to individual requirements. Write for bulletin HF-2 which describes the HYDRAULIC FILTERS.

Circle 36 on Reader Service Card

Literature can be secured on HYDRAULIC and PNEUMATIC WEIGHING, by writing The A. H. Emery Company. Information on stock, or specially designed systems, may be obtained, in order to solve your force measuring problem.

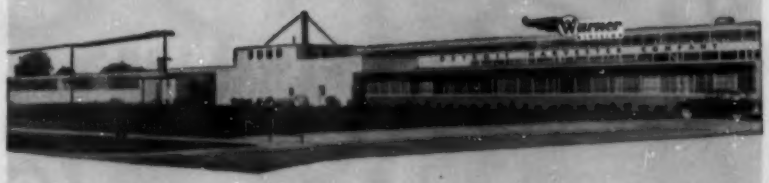
Circle 44 on Reader Service Card

FLUID LINE COUPLINGS, which are quick-connective, are described in literature available from The Hansen Manufacturing Company. Couplings for one-way shut off and two-way shut off, also straight through quick-connective couplings, are included.

Circle 60 on Reader Service Card

Continued on next page

To Better Serve You



Warner Doubles Plant Facilities
Steps-up Precision Subcontracting Work

THE Warner Division of Detroit Harvester Company has moved into a new and larger manufacturing plant.

In addition to permitting an increase in the production of hydraulic units of their own design, such as pumps, valves and actuators, this expansion places Warner in a position to take on additional precision subcontracting work for aircraft and ordnance plants.

Capitalize on Warner's ability to manufacture to exacting tolerances.

Consider Warner for the production of—

Landing Gear Cylinders, Pumps, and Valves
Hydraulic and Pneumatic Assemblies
Aircraft Fittings
Machining of Aircraft Forgings

Contact our home office in Detroit or the branch office nearest to you. Warner engineers will welcome the opportunity to serve you.

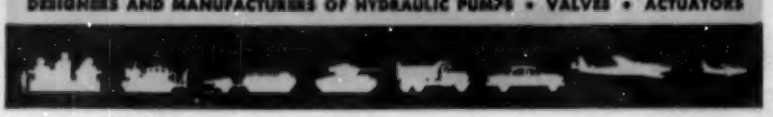
J. J. McCARTHY
520 West Avenue, Room 212
Norwalk, Connecticut
Phone: Volunteer 6-1534

C. PALMER BOYLES
56 Canterbury Drive
Dayton 9, Ohio
Phone: Walnut 4247

JESSUP ENGINEERING CO.
7227 W. 90th St.
Los Angeles 45, California
Phone: Orchard 2-1616

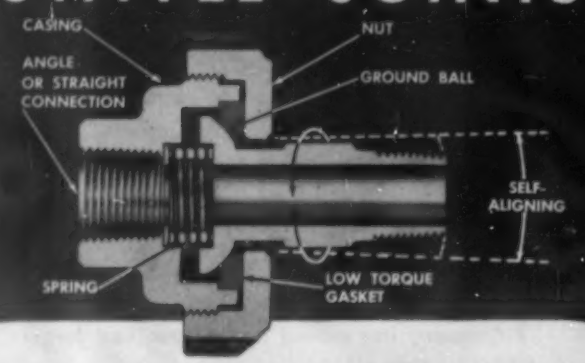
M. E. DOUGLAS
2242 Forest Park Blvd.
Fort Worth 10, Texas
Phone: Wilson 0555

Warner DIVISION OF DETROIT HARVESTER COMPANY
14300 TIREMAN AVENUE • DETROIT 28, MICHIGAN
DESIGNERS AND MANUFACTURERS OF HYDRAULIC PUMPS • VALVES • ACTUATORS



Circle 124 on Reader Service Card

SELF-ALIGNING BARCO SWIVEL JOINTS

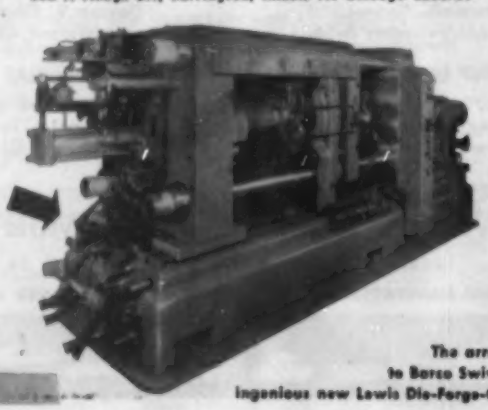


Speed up Adjustments on LEWIS DIE-FORGE-CASTING MACHINE

LEWIS WELDING & ENGINEERING CORP., Bedford, Ohio, is one of the many well-known machinery builders who rely on BARCO SWIVEL JOINTS for flexible piping connections to *moving* or *movable* hydraulic cylinders. In this case, the cylinder is mounted on the movable strain head of the machine. Thanks to Barco joints, the position of this head can be changed easily at any time without concern about the piping connections. The joints also safely absorb all movement and strain on piping when the machine delivers its final closing force of 650 tons.

Barco Swivel Joints also save time on initial installation of piping because they are *self-aligning*—EXACT PIPE FITTING IS NOT NECESSARY TO PREVENT "BINDING". This is an exclusive Barco advantage. *For complete information, ask for Catalog 265.*

BARCO MANUFACTURING COMPANY
933 H Hough St., Barrington, Illinois *(A Chicago Suburb)*



The arrow at left points to Barco Swivel Joints on this ingenious new Lewis Die-Forge-Casting Machine.

Free Literature Offered in this Month's Ads

Continued

Waterman Engineering Company is offering an illustrated circular A, covering their FLOW REGULATORS and VALVES. The range of sizes and the variety of models are included.

Circle 125 on Reader Service Card

Write to Organic Chemicals Division, Monsanto Chemical Company, for a booklet on Pydraul, the FIRE RESISTANT HYDRAULIC FLUID for industrial applications.

Circle 90 on Reader Service Card

An illustrated catalog, which describes 185 stock PUMPS, may be obtained by writing Brown & Sharpe. Features, capacities and pressures are given.

Circle 22 on Reader Service Card

AIR CYLINDERS, in many standard sizes and styles for pushing pulling, lifting and other control jobs, are presented in bulletin 454, which is released by The Tomkins-Johnson Co.

Circle 116 on Reader Service Card

VALVES for air and hydraulic use are described in a circular which may be obtained from Pneu-Trol Devices, Inc.

Circle 97 on Reader Service Card

Self-aligning BEARINGS for piston rod ends are described in an engineering manual available from Southwest Products Co.

Circle 104 on Reader Service Card

Have a sludge problem? Write to W. H. Nicholson & Co. for catalog 953 covering their new AIR TRAP.

Circle 92 on Reader Service Card

Bulletin No. 4502, released by Darling Valve & Manufacturing Co., gives PACKING sizes and engineered textures, suitable for virtually any service.

Circle 33 on Reader Service Card

Continued on page 51

hydraulic power

with Eastern Hydraulic Pumps and Fluid Motors

When your product-application calls for dependable power think of Eastern, a leader in the design, development and production of small hydraulic units. They have proved dependable and space saving in hundreds of specialized products.

Eastern designing and engineering skill in helping you choose a pump or fluid motor puts at your disposal all-important standard — to recommend a unit that performs its job reliably, while keeping size and weight to a minimum. The result is an improved product — smaller, lighter, less expensive — and with equal or better performance.

For a catalog with helpful design information, practical and engineering data, send for Eastern Bulletin A-800.

Eastern

INDUSTRIES, INC.

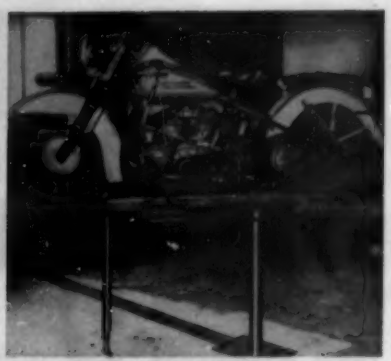
605 ELM STREET

NEW HAVEN, CONN.

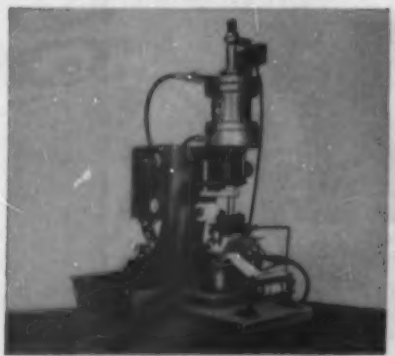
Circle 41 on Reader Service Card

Lindberg Cylinders are used on Machine Tools

... and Clamping Machines



... and Material Lifting Equipment



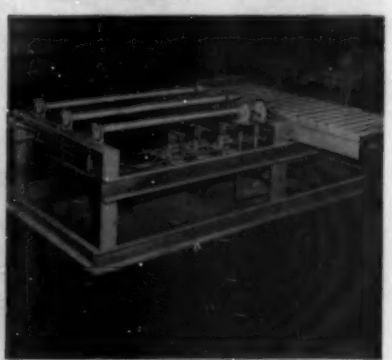
... and Marking Machines

... and Steel Mill Material Handling Equipment

... and Heat Treating Furnaces

... and Hydraulic Presses

... and Cutting Machines



... and Automation Lines

Original Equipment Manufacturers use *LINDBERG* Cylinders

(Lindberg offers a complete line of Air and Hydraulic Cylinders. Ask for Bulletin No. 800)

LINDBERG AIR..HYDRAULIC CYLINDERS

Lindberg Air and Hydraulic Division, Lindberg Engineering Company, 2441 North Laflin Street, Chicago 7, Illinois

Free Literature Offered in this Month's Ads

Continued

"See What Timing can do for You?", is the name of a booklet on AUTOMATION, released by Eagle Signal Corp. Problems of relating and coordinating machines and processes automatically, are discussed.

Circle 40 on Reader Service Card

Where constant volume must be maintained, CHECK VALVES with floating "O" ring construction are explained. Catalog available from James-Pond-Clark.

Circle 69 on Reader Service Card

Hydromotor Division, The Bonnot Co. is offering bulletin 521, describing the applications and engineering details of their HYDROMOTOR a rotary, reciprating air or oil cylinder.

Circle 68 on Reader Service Card

Several catalogs are available, from the Logansport Machine Co. Inc., covering products for air and hydraulic circuits. Catalog 100-4 presents AIR CONTROL VALVES.

Circle 81 on Reader Service Card

HOSE COUPLINGS and FITTINGS are described in catalog 101. It is available from Eastman Manufacturing Company.

Circle 42 on Reader Service Card

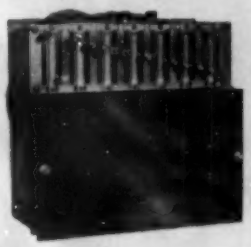
An engineering handbook and technical literature can be obtained from C. W. Marsh Company, on their IMPREGNATED LEATHER PACKINGS.

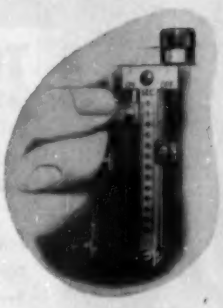
Circle 83 on Reader Service Card

Descriptive literature on SEALGUARDS can be secured from Hydraulic Accessories Co. Available to fit rod diameters to 10 in., they mold themselves to the shaft contour.

Circle 63 on Reader Service Card

Let EAGLE put profit in your process





Television tubes can now be coated automatically with a new metallizing unit developed by F. J. Stokes Machine Co. All operations—closing and opening of valves,—starting and stopping of vacuum pumps,—on and off of vaporizing current,—all are controlled by one Eagle Multiflex Timer. Let Eagle timers speed up production, increase quality, and reduce rejects for greater profit for you. Eagle builds a timer for every timing problem.

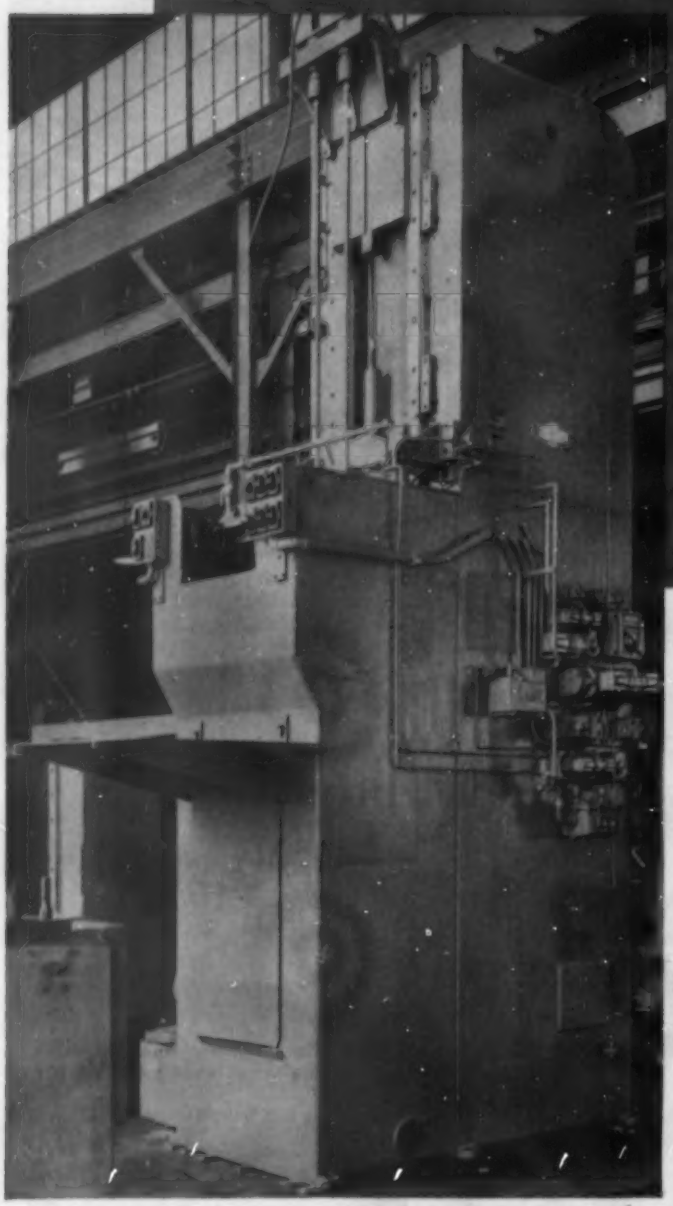
Automation STARTS WITH EAGLE Timers FOR ANY SIZE INDUSTRY

Send for FREE Automation Booklet "See what timing can do for you?"

Industrial Timers by EAGLE

EAGLE SIGNAL CORPORATION MOLINE, ILL.

Hydraulic machine tool builder demands NO SLUDGE — NO RUST NO FOAM



TO ASSURE satisfactory performance of his hydraulically controlled and operated machines, this builder (name on request) uses and recommends *Texaco Regal Oil R&O* as the hydraulic medium.

This is the oil that tests prove has *more than ten times the oxidation-resistance* of ordinary turbine quality oils — far greater ability to assure freedom from sludge, rust and foam.

To keep your hydraulic machines operating without unscheduled stoppages . . . to assure clean, smooth hydraulic operation, with longer life for pumps and other parts . . . use *Texaco Regal Oil R&O*. There is a complete line of these famous oils to meet your particular equipment and operating conditions.

A Texaco Lubrication Engineer will gladly help you. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils R & O

FOR ALL HYDRAULIC UNITS

What's So New About AUTOMATION?

This is no second industrial revolution. Mass production by means of "mechanization" has been going on for a long time. However, because of changing needs, there is greater stress today on the application of automatic machinery.

THERE is nothing particularly new in the concept of automatic operation. In chemical, food processing, rubber and glass industries, bottling and canning plants, and paper mills, automatic processes have long been in use. What has given impetus to greater application of automatic equipment throughout industry? Mainly, it has been due to changing demands in product quality, quantity and cost. Management is looking for methods to make parts better, faster and cheaper. Machine designers now have available efficient and dependable air and hydraulic components which can be automatically controlled to power the loading, transferring and unloading operations which are necessary to improve production methods.

Recently, the foundry and metal working industries have begun widespread application of fluid power to automatic machines. However, some operations, particularly assembly, cannot be made automatic. For some operations, automatic machines are possible but not economical, and for many operations partial automation will meet the needs of lower costs, better quality and higher production.

WHAT THE MACHINE DESIGNER MUST KNOW

Designers of automatic equipment must be familiar with hydraulic and pneumatic circuits and electrical controls. A knowledge of several standard transfer systems which have been developed, can be applied to many automatic production lines.

Like any complex design, the automatic line can be broken into many smaller design units which depend on a knowledge of basic mechanisms. Hydraulic and air devices will be used to clamp, push, pull, index, tilt, rollover, rotate, raise, lower, etc. Power applied by cylinders and fluid motors is transmitted directly or through toggles, gears, ratchets or other mechanical linkages which will provide the necessary motions.

Accurate control of cycle time now becomes more important than

ever before. Cycle time variations in one machine of an automatic line will upset the entire line. To maintain the production cycle, accurate, repetitive work feed systems must be designed. Use of adjustable flow control valves makes it possible to easily vary speeds of oil and air powered cylinders. Quick positive braking of motions and smooth reversals are attainable.

Constant oil temperature in hydraulic systems becomes critical for accurate speed control. An understanding of feed control systems and electrical cycle control is essential. In Ransom Tyler's article, page 64, the application of recent developments in hydraulic feedback control of speeds is discussed. To the designer of automatic equipment which requires very precise speed regulation under varying operating conditions, a knowledge of the advantages and design of hydraulic and pneumatic servosystems is necessary.

The designer must also be able to provide flexibility. Automatic equipment need not be designed for a "one purpose" job. Loading and transfer devices should be adaptable for use with other machine tools. Use of standard electrical, air, hydraulic and mechanical components reduce machine cost and increase flexibility.

COST OF AUTOMATIC EQUIPMENT

Your automatic machine program could cost as little as several hundred dollars. It all depends upon how far you need to go. The important point is that automatic machinery is not the exclusive property of the large plant. An automatic machine can be used for one operation, a single department or an entire plant. How far you go depends more on the long run returns rather than on the initial cost.

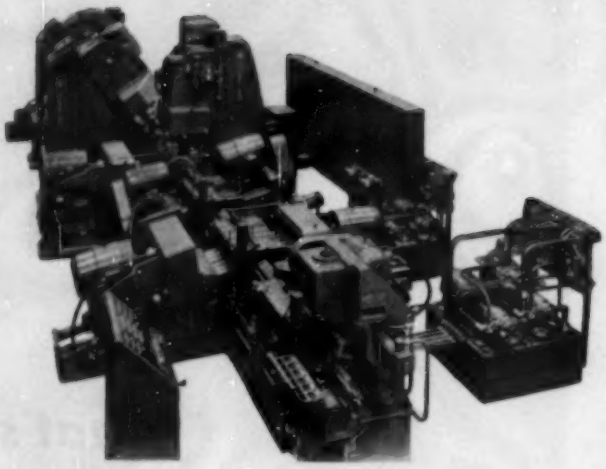
The Cross Company of Detroit, who have designed and built many transfer machines have developed typical cost analyses which indicate that the choice of the best process is accomplished by comparing the merits of several proposed plans over a one year period. Each proposed plan takes into account all factors of the company's profit, including sales income, material, labor, factory expenses, administrative expenses, interest and income taxes.

MAINTENANCE IN THE AUTOMATIC PLANT

There has been some speculation about the titles of shop personnel in the "automatic plant". Instead of machine operators, the title "machine manager" has been suggested. Because the function of operating the machine will be taken over by an automatic control system, the machine manager will be a skilled technician whose knowledge of machine maintenance will prevent costly downtime.

It is up to the machine designer to make this maintenance job easy. Parts requiring scheduled maintenance must be accessible. In the case of hydraulic systems, reservoir, pump and electric drive motor are kept as a separate unit rather than integral with machine housings. Today, cylinders are seldom cast into the machine frame.

Hydraulic and pneumatic plumbing is laid out so



that fittings and lines may be serviced. Air bleeds are conveniently placed to keep oil systems operating without malfunction caused by trapped air. Filters are installed on hydraulic systems to remove the major causes of trouble—dirt and water. For pneumatic systems, the designer has available filter-lubricator-regulator units which remove foreign matter, assure necessary lubrication to moving valve and cylinder parts, and to control operating pressures.

Test equipment is being made available to machine managers to permit quick location of trouble spots. The machine designer is providing test points and gauges wherever necessary in the air and hydraulic circuits.

ELECTRO-HYDRAULIC COOPERATION

Because accurate control is essential, hydraulic and pneumatic valves are being actuated electrically. Every contingency is being anticipated through limit switches, relays, pressure switches and timers. Control panels

This Automatic Machinery Issue will help you . . .

- . . . layout pneumatic and hydraulic circuits
- . . . select electrical control systems
- . . . apply servo controls to industrial machines
- . . . design fluid powered work handling devices

with signal lights are designed to give a visual check of the operation of each machine in the automatic line. The panel warns the machine manager of dull tools, improper timing or component failure.

Electrical interlocks assure safety to both the machine and the work. Switches are used to indicate when a part is in the unload station; when a load station is ready to receive a part; and when the part is properly loaded.

All control relays are grouped at a panel for quick identification and service.

Success of modern automatic machinery depends on a combination of hydraulic, pneumatic, electrical and mechanical components.

CONTROL CIRCUITS

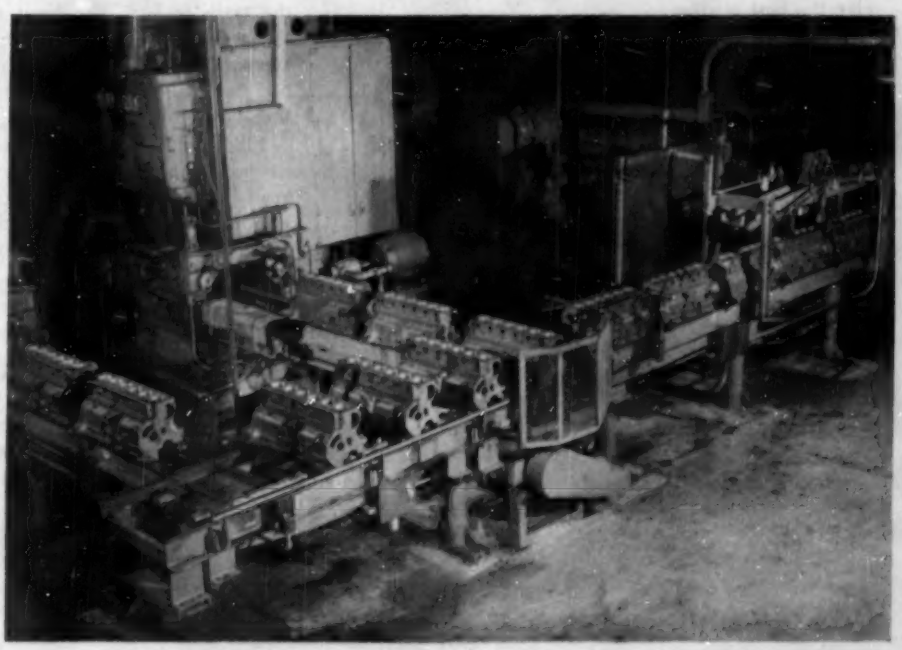
for Fluid Powered Work Transfers

Electrical interlocks for air and oil powered transfer devices provide proper cycle timing and safety to the work and machine.

AIR and electrical circuits for a typical work transfer system which connects two automatic machines are described in this article. These circuits illustrate the solution to automatic work handling problems. Whether your transfer machine has one work handling section or many sections to move the workpiece through all the automatic operations, the basic design problems are the same.

The major problem is to arrange the timing of the automatic work handling system with the cycles of the machine tools in the line. The transfer section must unload work from one machine and load it into the next machine only when the machines are ready to discharge and accept the work.

Power for the transfer can be applied by either pneumatics or hydraulics. The selection of air or oil largely depends on the loads and speeds. An air cylinder, cushioned at both ends is capable of powering



SEVERAL TRANSFER DEVICES are used in this section of the cylinder block machining lines in the Ford Cleveland Engine Plant. Automatic air powered transfer mechanisms move the blocks lengthwise and broadside.

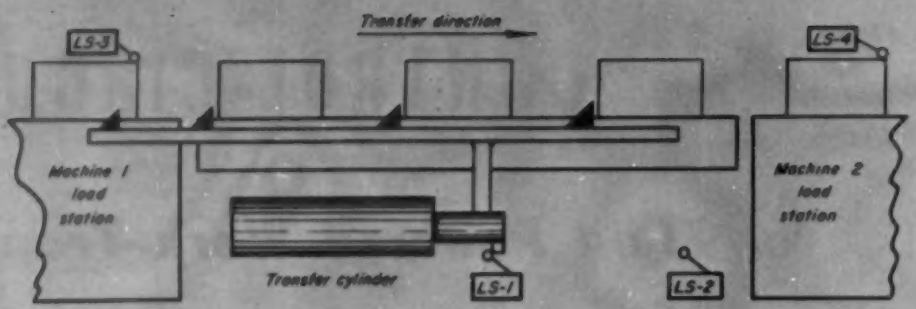


FIG. 1. Schematic layout of the mechanical components in a straight-line transfer mechanism. The transfer cylinder, powered by pneumatics or hydraulics, automatically moves the workpiece between the two automatic machines.

many straight-line work transfer jobs at high speed and without undesirable shock. Excellent control of air power can be provided when the load is primarily a friction load. Where the work must be pushed up hill, or where heavy index tables are used, oil power is preferred. On jobs where the work load varies during the transfer stroke, a hydraulic power circuit can be arranged to assure constant smooth transferring. Under varying load conditions, smooth travel would be difficult to attain with an air circuit. Transfer speeds can be varied over a very wide range. For safe top speeds, air pistons should be kept to 8 ft per sec, and hydraulic pistons operating at 2 to 3 ft per sec will give the best results.

USE OF PRETRAVEL IMPACT

Determining the stroke of the air or hydraulic cylinder depends on the maximum distance which the workpiece must be transferred. The cylinder stroke is generally made longer than part movement to take care of any variations in the size of the workpiece and to allow the piston to develop some pretravel impact before the transfer latches pickup the work. This impact helps to break static friction.

Since it is advisable to use meter-out circuits to control the speed of the transfer cylinder, bores must be large enough to assure sufficient volume of air or oil for metering from the rod end.

The air circuit shown here has a long stroke transfer cylinder controlled by two 3-way, two position solenoid operated air valves. Both valves are normally open when the solenoids are deenergized. This allows air to enter both ports of the cylinder to stop travel at any point of the stroke. Because of the difference in areas on opposite sides of the piston head, a pressure regulator is used to reduce the pressure on the blank end to balance the forces on both sides of the piston head.

Flow control valves in lines to the rod and blank end are effective in both directions of travel.

Proper timing and control of the fluid powered transfer depends on the electrical control circuit. Figure 1 shows the mechanical layout of a straight line transfer mechanism between two machines. The mechanism is powered by the air circuit shown in Figure 2 and controlled by the electrical circuit shown in Figure 3. This particular transfer is in the returned position when the section is idle. When the electrical control is set for automatic operation, four limit switches operating through suitable control relays energize the solenoid air valves to cause movement of the transfer bar. The limit switches are tripped by the work and by shuttle cylinder movement. Two switches sense the position of the transfer bar and one each governs loading and unloading of work in the machines.

Electrical interlocks are established to assure that movement only takes place when the machines are ready to accept new parts. In most cases, this requires an interlock at the load and unload stations. Interlocks must prevent machine operation if a part is not properly loaded.

LIMIT SWITCH CONTROL

With the transfer bar, Figure 1, in the return position and the selector switch in "automatic", pressing the start button initiates forward travel. The four limit switches and three relay contacts are in series with the forward solenoid relay to assure safe transfer. One limit switch, LS-1, indicates the transfer is fully retracted; LS-4 indicates that the loading stations are clear; and LS-3 indicates the machine being unloaded is ready.

Colored lights on the control panel, as indicated in Figure 3, provide visual signals. When the start but-

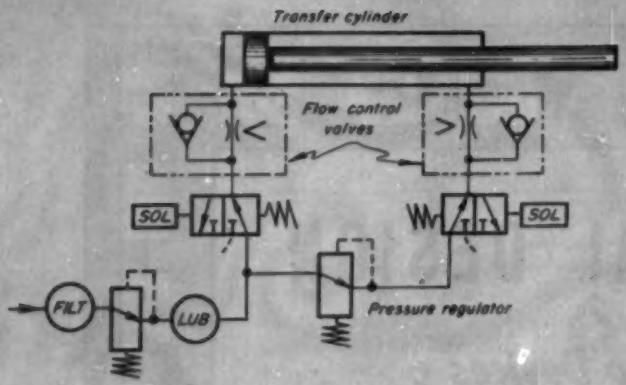


FIG. 2. Pneumatic circuit powers the transfer cylinder. A similar circuit using oil power is often used.

. . . automatic machine lines need circuits which initiate work transfer only when unload and load stations are ready

ton is pushed, the green light glows, and with the selector switch in "automatic" the red light glows.

Relay CR-1 controls the forward solenoid through two normally open contacts. To initiate the forward transfer, LS-3 must be tripped by machine 1 in the unload station; LS-1 is tripped by the transfer piston in the return position and control contacts CR-W and CR-Y must be closed. Relay CR-W indicates that machine 1 has completed the unload movements. Relay CR-Y indicates that machine 2 is ready to receive a part. Once the transfer motion is started, LS-1, LS-3 and LS-4 are bypassed by CR-1 contacts. When the transfer piston completes its forward stroke, LS-2 is tripped to deenergize CR-1 and energize CR-2 causing return of the transfer cylinder.

Relay CR-ST provides automatic starting of machine 2. It is energized by LS-4 and CR-2 when the part is in the load position. It bypasses the pushbuttons on the machine to prevent the machine being started out of cycle by pushbutton. LS-2 has to energize CR-2 before machine 2 can be started.

A study of these circuits shows the application of a simple electrically controlled transfer system in which every operation and safety contingency is anticipated.

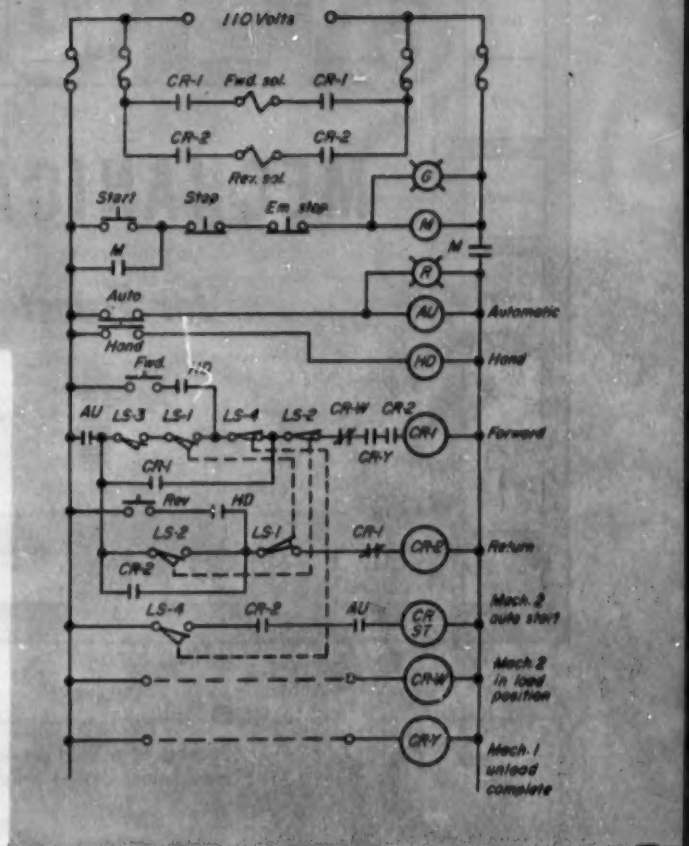
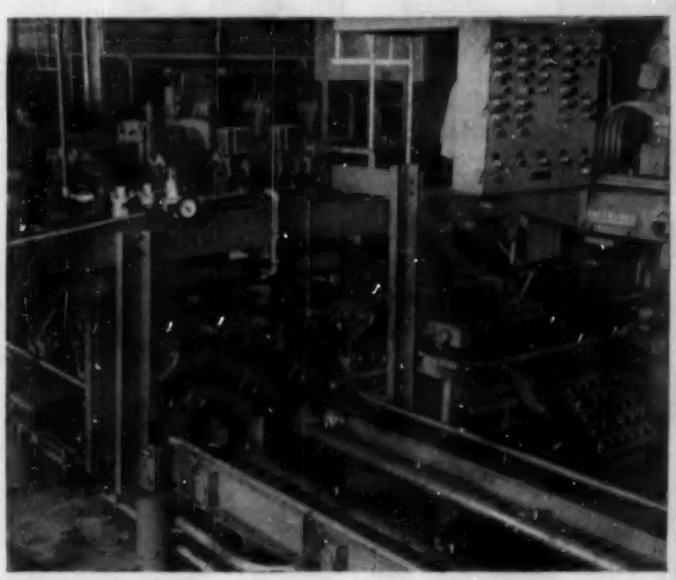
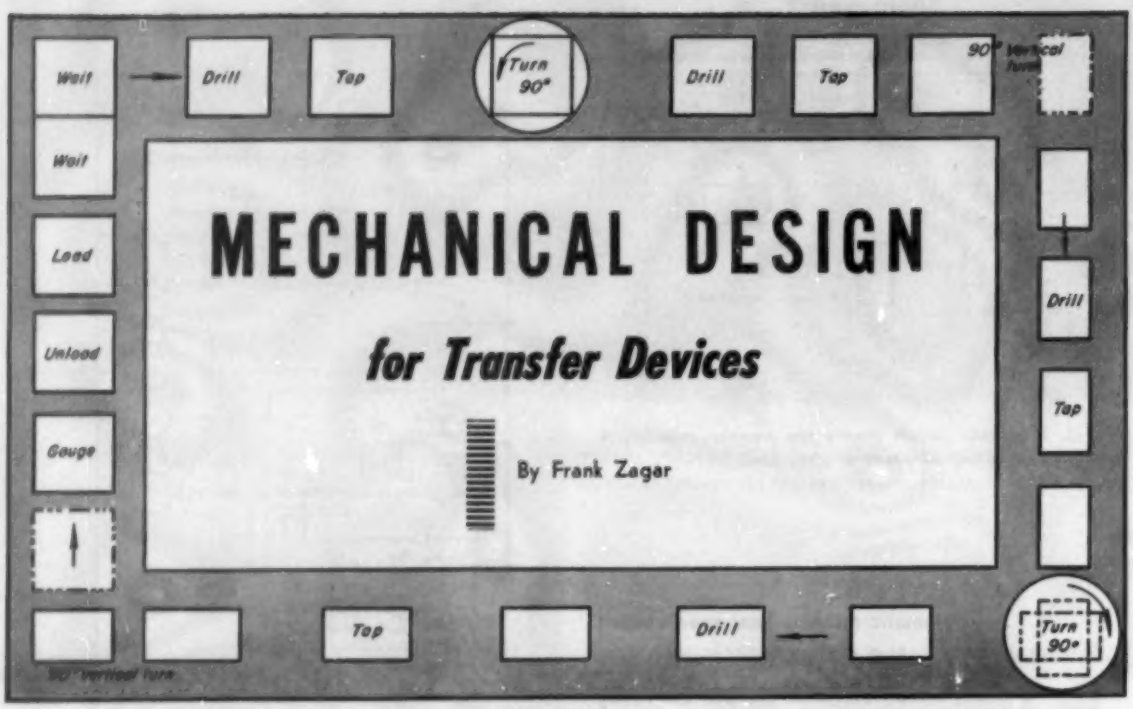


FIG. 3. Electrical control links the automatic machines with the automatic transfer device.



BOTH OVERHEAD AND BROADSIDE transfer mechanisms are shown in this view of equipment in the Ford Cleveland Engine Plant. Air cylinders, controlled by solenoid operated air valves power the transfer. The broadside transfer bar has latch fingers which pick up and move the 180 pound casting between stations.



Success of a fluid powered transfer machine requires the application of sound mechanical design practices.

MUCH has been and will be said about the development and use of reliable hydraulic, pneumatic and electrical components on modern automatic equipment. These power and control components are only part of the story. They can only be made effective if the mechanical devices which link them to the work are properly developed.

Mechanical linkages on a machine layout, similar to the one shown in Figure 1, may appear complex because of the size of the machine and because so many devices are needed. Nevertheless, each mechanism taken by itself is not and should not be complex if satisfactory life is to be had.

A knowledge of common mechanical components such as toggles, latches, racks and pinions, bearings, springs and cams coupled with careful layout work on the drawing board and with ingenuity result in transfer mechanisms like those illustrated in this article.

The machine layout drawing, Figure 1, represents automatic equipment which was designed and built by Zagar Tool, Inc., Cleveland, to complete the drilling and tapping of die cast housings used in office equipment. Work had to be done on all six sides of the parts. In the initial design stage, it was determined how many drilling and tapping stations were required. Rough machine layouts were sketched to indicate the desired stations for loading drilling, tapping, gauging, indexing, cleaning and unloading. A decision based largely on plant layout was made to move the work in a rectangular pattern instead of straight line or some other possible pattern. The rectangular pattern puts the load and unload stations within reach of one man.

FRANK ZAGAR, General Manager, Zagar Tool, Inc., Cleveland, O.

DIVIDING THE DESIGN LOAD

With the machine plan determined, overall design can be divided into distinct sections which can be handled by separate design groups. Work handling and positioning devices are for the most part hydraulically powered. Two work pieces are loaded into a box type drilling and tapping jig which becomes the work carrier or pallet. These loaded pallets are placed

FIG. 1. The MACHINE LAYOUT on the opposite page shows the required stations for the transfer machine and to the necessary motions which must be imparted to the work piece as it is automatically carried from load to unload. On transfer machines having part movement in a different pattern, the basic transfer devices will be similar.

on a section of gravity feed roller conveyor from which they roll into the first corner of the transfer machine. Enough room in the loading section is provided to permit storage of several loaded pallets.

Straight linear transfer between stations is provided by the hydraulically powered transfer mechanism shown in Figure 3. The total stroke of the cylinder is 34 inches, which is slightly more than the maximum distance between any two stations in the line. Positioning of the latches is arranged to result in the desired pallet movement which is not equal between all stations. After the latches have moved the pallets into each station, oil powered clamps lock the pallets in position, and the transfer bar returns ready for the next transfer of work.

All work transfers are done at the same time. This greatly simplifies timing and electrical control circuits.

At two points on this machine, the pallets have to be turned 90 degrees. This takes place once between drilling stations along the first transfer line and again when the pallet is moved around the third corner of the machine. To make this turn, a turntable as shown in Figure 2 is used. This table is indexed by the action of the cylinder which powers the transfer bar. The drawing shows the index button which engages a lug on the underside of the table as the cylinder retracts. On the forward stroke, one pallet moves off the table and another is moved on, and on the return stroke of the cylinder the turntable rotates 90 degrees. The design of this mechanism is made to give smooth indexing motion without shock.

At the second corner, Figure 4, the pallet is turned vertically 90 degrees to permit drilling and tapping of the two other sides of the work piece. A clevis mounted

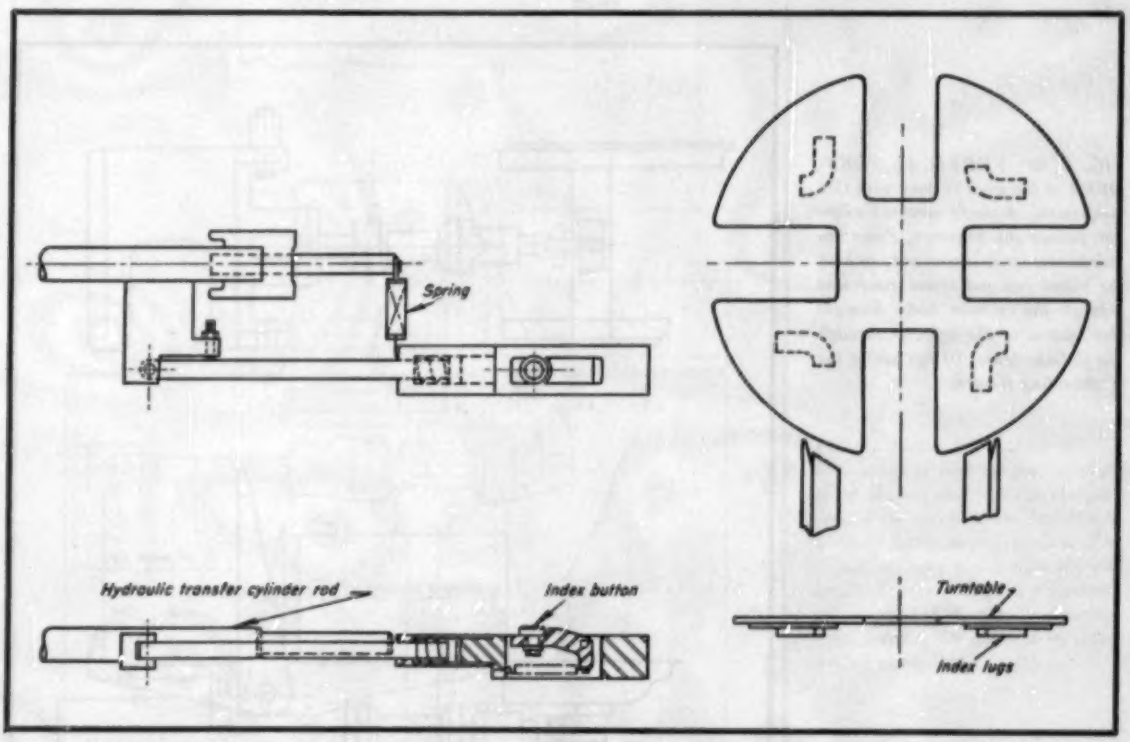


FIG. 2. TURNTABLE for rotating or indexing the part 90 degrees is powered by the same linear hydraulic or pneumatic cylinder which is used to power the transfer bar shown in Figure 3. As the cylinder moves forward, the index button slides under the index lug on the turntable. As the cylinder is retracted, the index button acts against the lug to rotate the table 90 degrees. Spring loading of the index button produces the desired action.

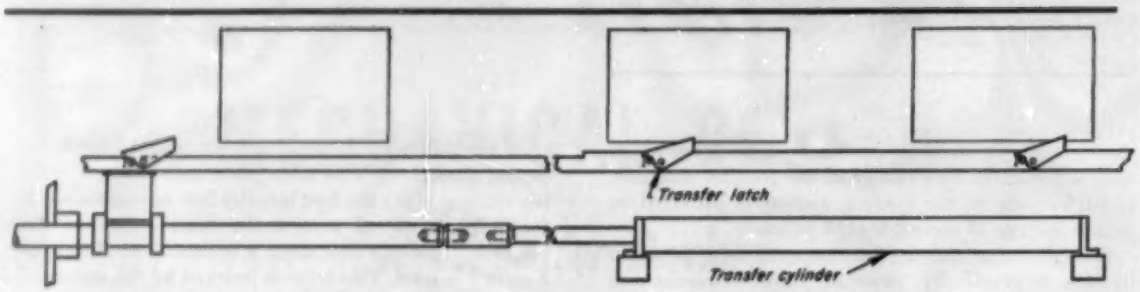
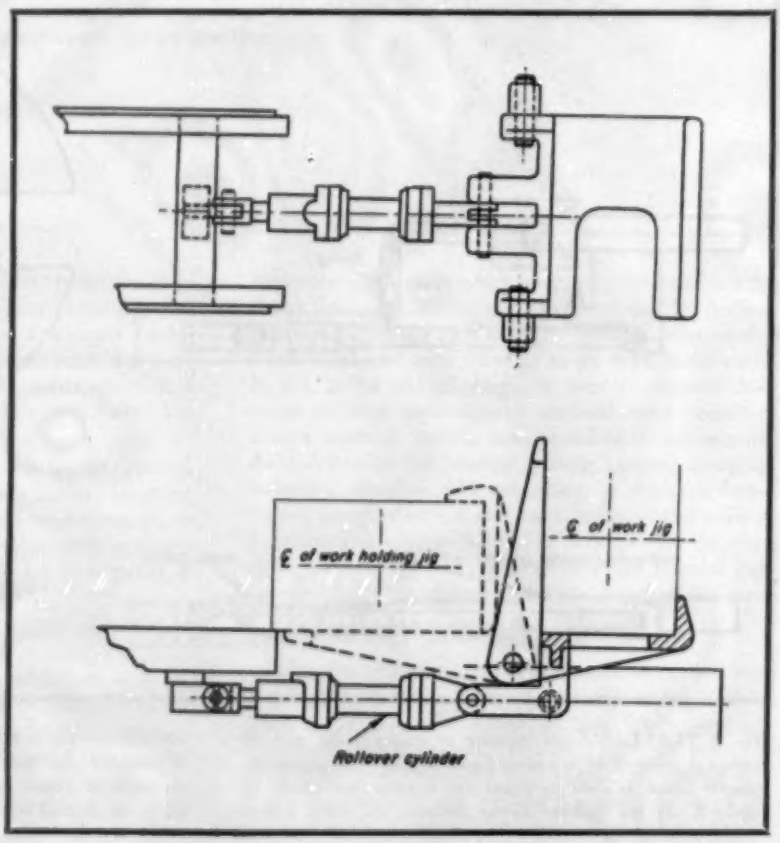


FIG. 3. TRANSFER BAR positions the work between stations along the straight sections of the machine. Unequal spacing between stations is accomplished by the use of the latches which pick up and carry the work piece.

cylinder rotates a hinge mounted pallet carrier 90 degrees. Because of space limitations, the end of the piston rod is pinned to a stationary point on the machine and the cylinder body moves to rotate the carrier. Hinge diameters provide adequate bearing and strength, and a relatively short length simplifies line up and assembly. Simple set screw and cotter pin fasteners are used on the pinned connections.

At the fourth corner, Figure 5, the turnover mechanism is modified to provide a pusher cylinder which moves the completed part onto a gravity feed conveyor. Again movement of the cylinder body causes rollover.

FIG. 4. 90° VERTICAL TURNOVER of the work is done with this mechanism. A clevis mounted cylinder powers the flop-over. Space requirements made it necessary to hold the piston rod and create movement through the cylinder body. Straight line motion of the cylinder through the linkage causes 90 rollover of the workholding fixture.



The pusher cylinder which is fastened to the pallet carrier moves with the carrier when it rotates as shown in the drawing. When the pallet is flopped over, the pusher moves it off the carrier.

Power for all the transfer cylinders on this machine is supplied by one pump through rigid tubing and flexible hose. Hydraulic systems for the drilling and tapping machines are independent of the transfer mechanism oil circuit.

Layout drawings of the mechanical transfer mechanisms assist in the selection of the hydraulic cylinders. Mounting styles and stroke lengths are determined from the drawings. While bore diameters depend primarily on desired force and speed, an initial layout helps to obtain proper proportions. Designing by proportion is a good starting place. Checks of loads and speeds often prove that the roughed in cylinder size will perform properly.

The devices shown here are typical of those used on many transfer machines. Along with the necessary motions, requirements of size, weight and space determine the design of these mechanisms.

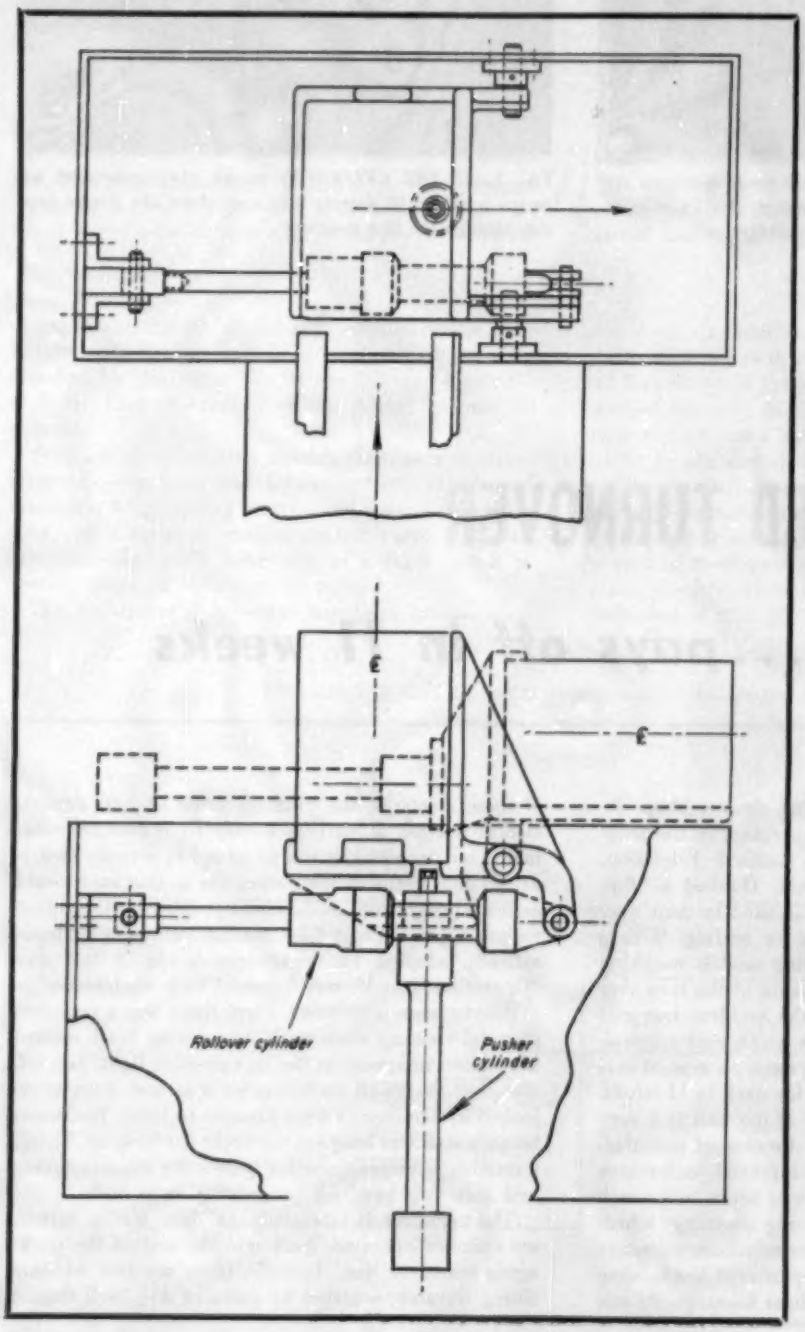


FIG. 5. TURNOVER AND PUSHING action to turn the part vertically 90 degrees and to move the part around the corner to the last station is done with two cylinders. The pusher cylinder moves with the fixture as it turns over. All movements are interlocked electrically when the limit switches are actuated by cylinder or piston rod travel.

FIG. 1. THE CARTON containing a 300 pound television set is run onto the first station of the turn-over. A pilot valve is hand operated, retracting the pair of cylinders.

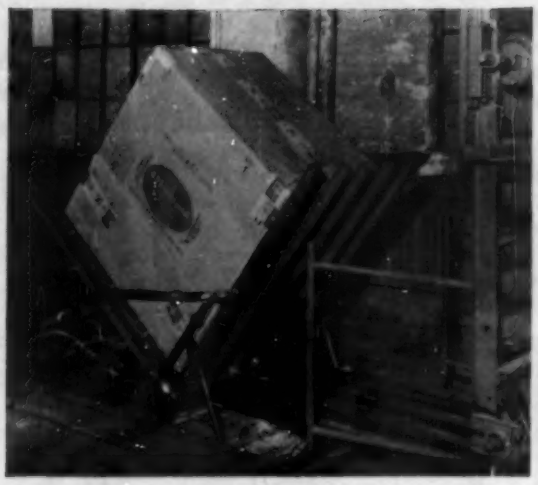


FIG. 2. AS THE CYLINDERS retract, the fixture with its carton is turned 90 degrees. The view shows the fixture part way through the first movement.

AIR OPERATED TURNOVER

. . . pays off in 11 weeks

AN air operated carton handling device, shop designed and built, is now in operation in the shipping department of the Olympic Radio & Television, Inc., Long Island City, N.Y. plant. Dubbed a "flip-flop" by the operators, the unit is used to turn over cartons containing television sets for sealing. With a total of 600 sets per day, including models weighing from 73 to 300 pounds, the operation of the turn-over resulted in a large reduction in the accident rate and in the labor turnover. The device which cost approximately $3500 is estimated to represent an annual saving of $24,000. The flip-flop paid for itself in 11 weeks.

The reason for the installation of the unit is a very interesting one. Benno Bordiga, director of manufacturing of the company has set up informal conferences with the heads of departments six or seven times each month for the purpose of discussing planning, scheduling, production problems, labor-relations, company procedures and developments. Department heads, shop stewards and sponsors attended these meetings. At one of these meetings, the problem arose of inter-departmental friction at various levels. To reduce or eliminate such problems, it was proposed to actually switch department heads or their stand-ins so that each could gain an insight into each others problems. "Operation Switch" was approved by management and enthusiastically adapted by department heads. A two day "Operation Switch" was followed by a conference.

Results were impressive. First, there was a complete physical cleanup since each department head wanted his section to appear in the best possible light. Second, many of the small inefficiencies that had been overlooked by familiarity were brought to light. The maintenance staff was busy for six weeks catching up. Third, a number of suggestions for improving manufacturing and materials handling procedures were made.

The turn-over is essentially a double tilting fixture, air cylinder operated, built into the end of the packaging conveyor line. Actually, there are two separate tilting fixtures, actuated by pairs of 4½ inch double

FIG. 3. WHEN THE FIRST 90 degree turn is completed, the carton actuates a 3-way pilot valve, which operates the second pair of cylinders to turn the second fixture 90 degrees.

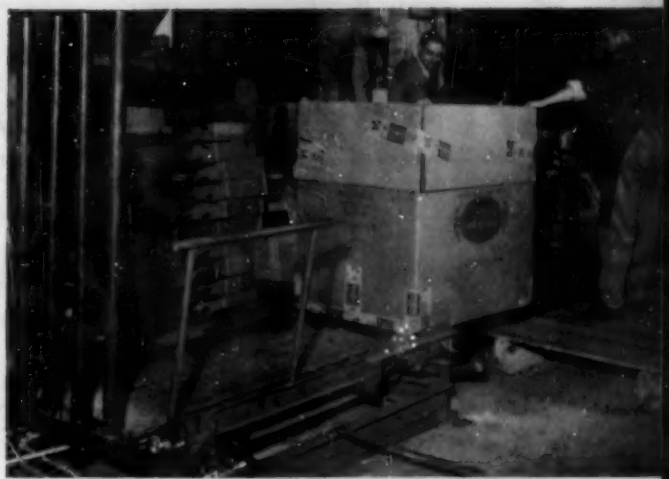


FIG. 4. WHEN THE SECOND 90 degree movement is completed, the carton rests on a belt conveyor which moves the carton, open end up, onto the roller conveyor.

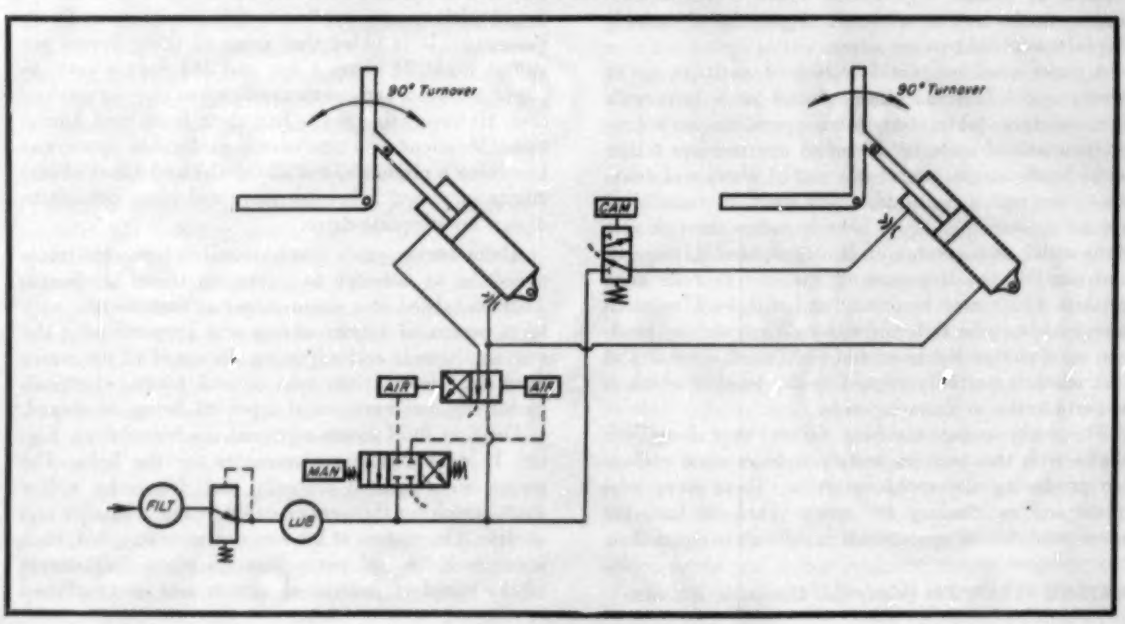
acting air cylinders, diagonally installed below each fixture, with the piston rods of each pair of cylinders attached by clevises to the fixture frames (Figures 1 and 3). Each fixture turns the loaded cartons 90 degrees.

Shop air at 80 psi after passing through a moisture separator, regulator and lubricator unit is directed through a 4-way spring return hand control valve to a 4-way pilot operated master control valve. A 3-way cam controlled pilot valve acts as a limit switch to operate pairs of cylinders in turn.

The air operated turn-over has been in operation for over six months. In addition to paying off its entire cost in less than three months, the best evidence of the success of the installation has been the enthusiasm of the men in the Packaging Department. It is now contemplated making the operation fully automatic by the use of a photo-electric activated switch.

The installation is an example of the effectiveness of utilizing suggestions of department heads and workers in improving operating and materials handling techniques in their own plant. Total savings through the plant, directly attributable to "Operation Switch" are estimated to total $50,000 per year.

FIG. 5. SCHEMATIC diagram of the air circuit for the turn-over fixture.



HYDRAULIC DRIVES *for Continuous Process Industries*

By Ransom Tyler

Precise speed control with variable speed drives is being made possible by the development of hydraulic feedback control circuits. These circuits are being used on paper machines and many similar processing machines which perform operations on a continuous web of material. In many processing plants, belt drives, shafts and cone pulleys are being replaced by modern automatically controlled hydraulic drives.

PRODUCTION of high quality paper and other products which are processed in continuous webs requires a machine drive which is flexible and convenient. The drive must operate smoothly and be capable of precise adjustment. These drive requirements can be met to a certain degree by a variable displacement fluid power drive.

A paper machine, is a collection of, perhaps, ten to twenty individual machines, placed in a line, with each machine performing some operation on a continuous web of material. The first one receives a thin white broth, strains out of it a mat of fibers and delivers to the next a continuous, wet sheet of material of almost no strength. From here it passes through sections which squeeze it, iron it, dry it, coat it, press it, and wind it up. It comes off the end in rolls as a product which may be strong and stiff, such as cardboard, or may be thin and filmy. Whatever the product, each section leaves an indelible mark upon it and that mark is partially related to the tension which it imparts to the web coming to it.

The early paper machine drives were long line shafts with the sections belted through cone pulleys for producing the speed variation. These were adequate and satisfactory for many years, in fact, for some condition of operation it is difficult to equal their performance. There are many mills operating today with drives of this type.

These mills require some variable speed source of power to drive the line shaft in order that the speed of the machine as a whole can be changed. Several hydraulic drives were applied to this service some thirty years ago. It is likley that some of those drives are still at work, 24 hours a day and 365 days a year, as paper machines run continuously when once in production. However, line shafts had their faults and limitations. Maintenance costs were considerable, space was becoming a premium, and as the size and speed of machines increased it became more and more difficult to design an adequate drive.

About twenty years ago sectional drives were introduced in an attempt to overcome these handicaps. These consisted of a single motor at each section with some means of synchronizing and proportioning the sectional speeds and adjusting the speed of the entire machine. These drives take several forms, electrical, hydraulic, and mechanical types all being developed.

The first fluid power sectional machine drives, Figure 1, were simple replacements for the belts. The pumps were located centrally and driven by a line shaft, which for this service could be much smaller and shorter. The motors at the sections were supplied, each from its individual pump through pipes. Adjustment of the speed of individual motors was accomplished

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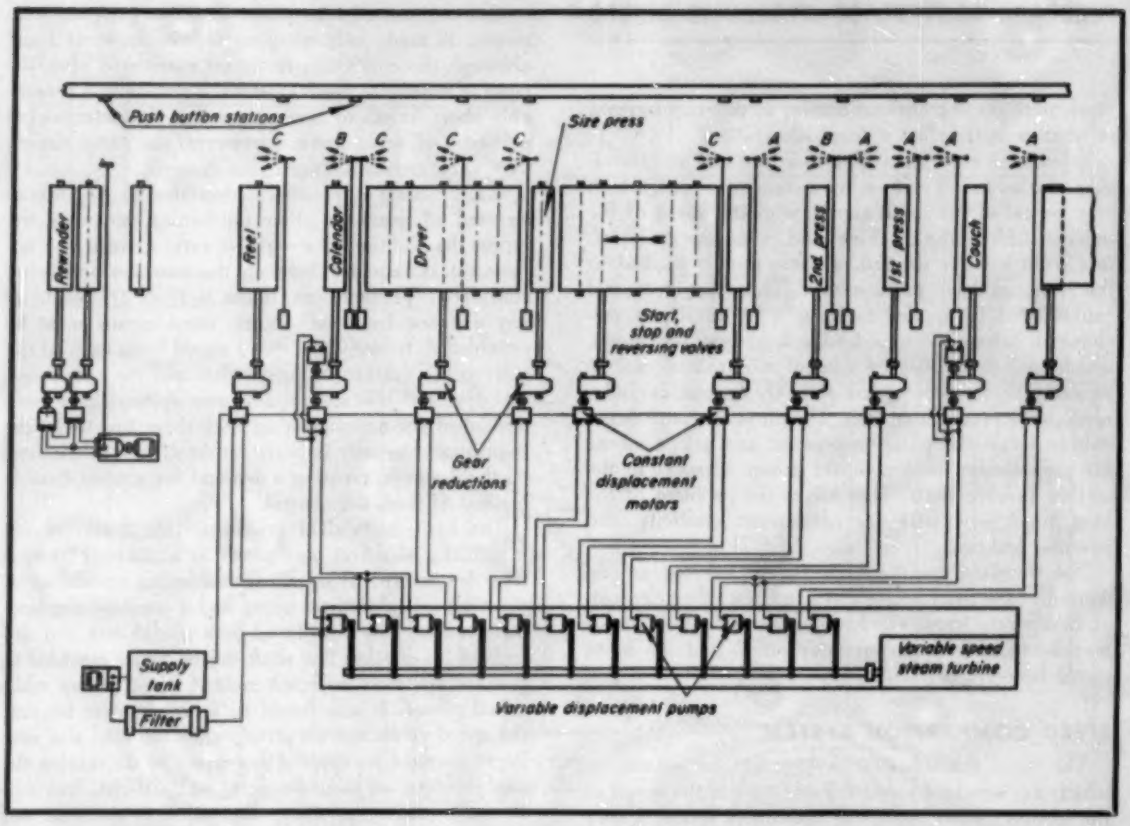


FIG. 1. THE FIRST fluid power sectional machine drives replaced the old belt drives to reduce maintenance costs, provide higher speeds and greater flexibility. There is a single motor at each section and a means of synchronizing and proportioning the sectional speeds. The centrally located pumps are driven by a line shaft.

by small electric motors, and a variable speed drive was still used for overall machine speed control. Valves replaced the large clumsy clutches and brakes for starting and stopping, in fact, entirely new functions could be obtained by the use of suitable valving.

LOWER OPERATING COSTS

With these drives the maintenance bill was cut and considerable building space was released for other uses. Higher speeds were possible due to the elimination of the long line shaft, and a degree of flexibility was obtained in rearranging the sequence of operation, or adding or deleting operations which was impossible with older drives. Of course, some rearrangement of operating techniques was required, but the operating personnel was readily trained and machines of this type have been operated satisfactorily for the last 20 years.

The sectional drive installation does have some shortcomings. First, in order to make an attractive and desirable system it is necessary that the pumps all be grouped along a short line shaft coupled to the variable speed prime mover which sets the overall speed of the process. Relatively long pipe lines are required to connect the pumps to the motors located at the section input shafts. Since hydraulic fluids are elastic (they have a modulus about 100 times that of steel) this results in periodic speed changes if disturbing forces such as unbalance in the rolls or out of round gears or bearings are encountered. Pipe line losses also contribute a significant amount of power loss, resulting in oil temperature rise. The speed controls are located on the pumps. This requires remote control over a considerable distance, generally accomplished by electrical means. The long pipe lines and many long runs of electric wiring are somewhat vulnerable to leakage of hydraulic oil and the common wiring failures encountered in any electric system. The hydraulic slip in this type system causes a small but troublesome change in speed when load changes occur, at such times when weights are changed on press or calender sections or when the web breaks releasing tension between sections.

A much more desirable system would be one in which pump and motor could be closely coupled, and in which controls could be easily extended to the oper-

ator's position. An obvious answer to this requirement is what is now called a feedback system.

A feedback control, applied to a sectional drive, consists of a means of comparing a standard speed, which may be called the input signal, with the speed of the indrive shaft to the machine, and, when the ratio differs from what is desired, a correction is applied to the sectional drive prime mover. This type of control can be, and is, applied to electric, hydraulic, or mechanical drives. With a feedback system the pump, which includes the speed control mechanism, can be located wherever convenient since the correction, only, needs to be transmitted to it. Thus it is easy and desirable to locate the pump and motor and prime mover for each section in a compact group adjacent to the section indrive shaft. This solves the problem of the long pipe lines with its consequent elasticity and possible leakage.

The standard speed source can be selected as one section of the machine, if this is a controlling element, or a separate small synchronous or induction motor may be located at the operator pulpit and the input signal be derived from it.

SPEED COMPARISON SYSTEM

The data transmission system or the means by which the standard speed is compared to the speed of the section indrive shaft, can take many forms. A very simple illustration could take the form of a shaft coupled to a motor serving as the standard speed. This shaft drives a screw, which engages a nut driven thru suitable gearing, at a speed proportional to the section indrive shaft. When the speeds of screw and nut are exactly equal the relative position of the nut and screw will be constant. However, the slightest difference in speed will cause a change in the position of the nut on the screw, and, if the speed difference persists the positional change will continue. The position of the nut on the screw can thus be considered a measure of the time integral of the difference in screw and nut speed.

Now, if a suitable control linkage is applied to the screw and attached to a potentiometer, or a control lever, or a throttle valve, and so arranged that the change in screw position moves the control element in the proper direction so that the speed of the indrive shaft will change in the proper direction, then the speeds of the nut and screw will again be equalized. The original speed error is "fed back" into the control of the power source to correct that error. This forms an elementary feedback system, or servo control to maintain the steady state speeds of two sections equal regardless of load or changes in speed of the leader of the two sections.

Such a system has three basic characteristics. One, a very small amount of power is stolen from the main drive system when an error occurs and is amplified and reinserted into the drive system to correct the error. Two, an error must first occur, and then a correcting action will take place. Three, a complete correction is made only after an infinite lapse of time, although the correction is almost completed after the lapse of a definite interval which is generally a reasonably short length of time. These are characteristic of any type of servo system, however, the exact timing may vary greatly between two systems.

A mechanical differential as described above, or constructed of gears or other mechanical elements, requires the addition of a variable ratio drive if any adjustment is required between the two sections being considered. Furthermore, if the sections are locatd at any distance from each other, some means must be provided to transmit the speed signal from each of the rolls to the differential mechanism and the speed control device. While several adequate systems have been developed for accomplishing both these functions, the requirement usually imposes rather drastic restrictions on the designer, creating a demand for a more flexible method of feedback control.

The basic method of providing this flexibility hydraulically was first used much as a matter of necessity. A standard hydraulic transmission, consisting of a variable displacement pump and a constant displacement motor, was introduced between the wet and dry ends of an existing line shaft driven paper machine to provide an easily adjusted method of supplying additional power. It was found to be inadequate because the speed variations occurring when the load was suddenly changed by rapidly increasing or decreasing the nip pressure on the calenders, while slight, was sufficient to cause operating difficulties. A decision was made to apply a hitherto untried method of feedback control to attempt to stabilize the drive, as shown in Figure 2.

Since the pump and motor, Figure 2, are positive displacement machines, the speed of the motor is almost

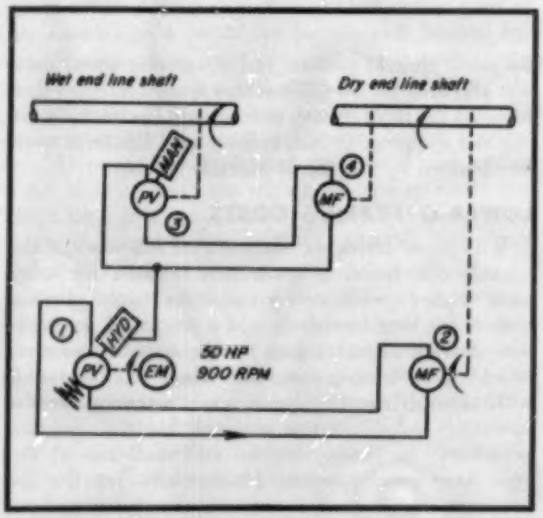


FIG. 2. SINGLE section feedback drive. Using positive displacement pump and motor makes the motor speed related to pump displacement. When wide ranges of speed are covered, varying pump slip can affect motor speed. Corrective measures, such as feedback control, must be taken.

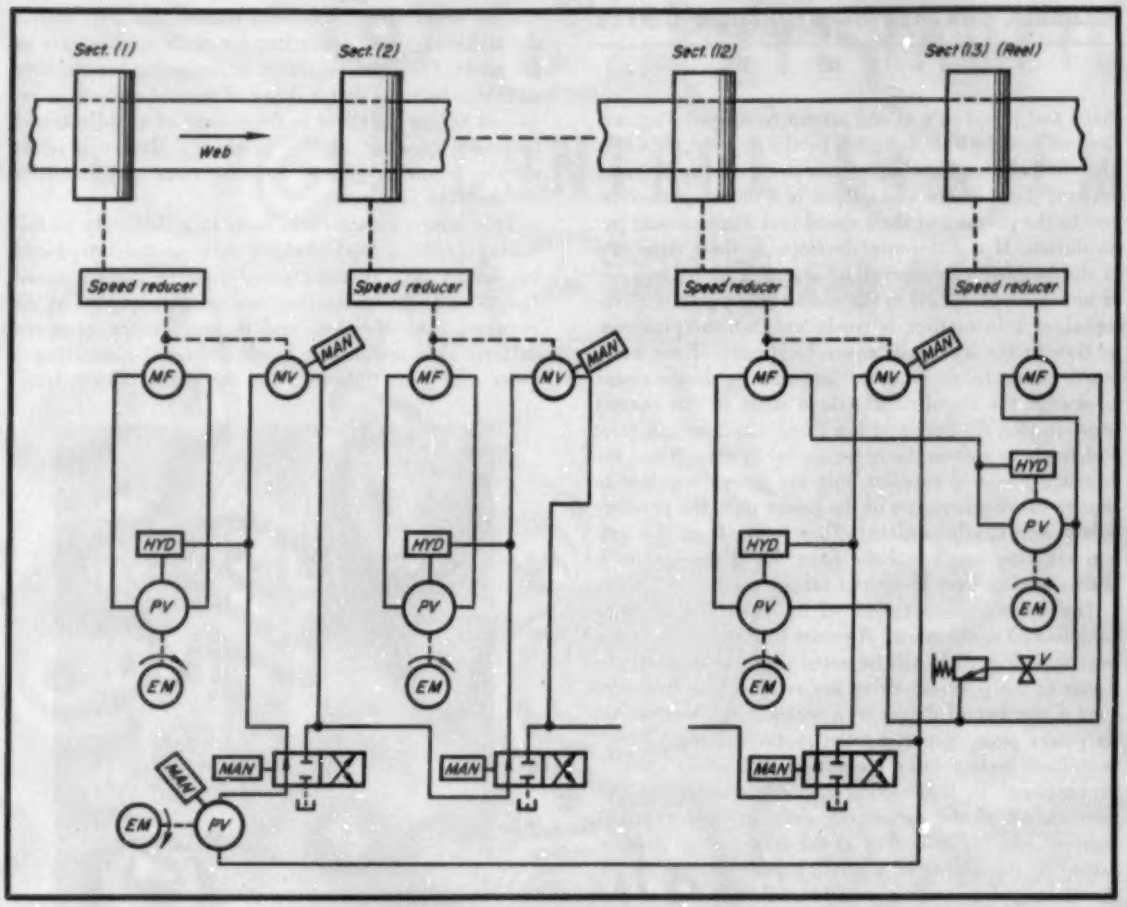


FIG. 3. SCHEMATIC of a section drive with feedback control of speeds.

precisely related to the displacement of the pump in a linear manner. It is only necessary to properly control the displacement of the pump to obtain any desired output speed within the design limits of units. At any fixed value of pump displacement a slight deviation from strict linearity occurs with changes in load and temperature. This change is due to slip or internal loss of working fluid in the power circuit and similar factors. This loss, while always rather small in absolute value, causes a greater percentage change in speeds when the output speed is low than when it is high. This difficulty can become very serious when wide ranges of speed are to be covered.

METHODS OF SLIP COMPENSATION

One method of overcoming this difficulty is to apply an artificial slip which is arranged to be higher at low pressures, and at low temperatures than at high pressures and at high temperatures. Some rather notable successes have been accomplished by this method, but at best it introduces an unnecessary loss in efficiency, and since the equipment is operating in opposition to the natural course dictated by the laws of nature it is difficult to produce and to adjust so that it will perform with precision.

A second method of compensation could be to adjust the displacement of the pump in response to changes of temperature and pressure so that the effect of slip is made up by an increase of stroke when slip is high. This method has also been used successfully, but here again the application is beset with difficulty. It is difficult to produce a device giving the same response to changes in two completely different variables. It is still more difficult to cause the compensator to work equally well at all points in a wide range of output speeds.

The feedback method of compensation depends upon the accurate measurement of the speeds of the wet end and dry end and comparing these actual speeds against the desired ratio as set by the operator. When the comparison shows a difference between the actual and desired ratio, or an error as it is called, compensating action is immediately and automatically undertaken by the measuring device to reduce the error.

In this type of circuit the error measuring means consists of a small, accurate, variable displacement pump (3) driven from the wet end, or master line

shaft, and piped in a closed circuit to a fixed displacement unit (4) which is driven by the dry end, or slave, line shaft. Since these units are positive displacement devices, their intake and output is a close approximation to the product of their speed and displacement per revolution. If a difference develops in their time rate of displacement an immediate signal appears as over or under supply of oil in the connecting pipe line. This signal, or information, is conducted thru the pipe connecting to the hydraulic control cylinder of the main power pump to decrease or increase its displacement to change the speed of the slave shaft in the correct sense so that the speed of the fixed displacement pilot unit tends to reduce the error signal to zero. Since the measuring system supplies only the power required to change the displacement of the power unit, the pressure is low, and nearly constant. Thus losses from this system are very small and the linearity of the system is almost perfect over the speed ranges used.

The successful operation of this unit led to more complicated applications. A recent installation is shown in part in Fig. 3. It will be noted that the essential elements of the previous drive are retained but extended over a number of drives in a series. Each section has its power pump supplying the motor driving the section. Each section has a measuring unit whose speed is proportional to the section speed. However, in this instance all of the measuring units are connected in a series, and the fluid flow in the pilot system is determined by the setting of a small, master unit located at the principal operating position. The output of this master unit must be absorbed by each of the follower units or the speed correction will be made by the main power pump. Additional functions may also be provided by valving in the pilot circuit. A 3-way valve is shown which bypasses the follower unit and drains the control when it becomes desirable to cut out one section. Additional controls can be provided to give a controlled rate of acceleration or braking, or a reduced jogging speed for testing or adjustment.

A feedback system of this type requires that an error occur before it is corrected. If the correction is made slowly the error will accumulate and become large; if it is made too fast it is inevitable that an overcorrection will be made and several cycles of alternating errors will occur before the correction is accomplished. If the correction is made even faster an uncontrolled oscillation will result which grows in magnitude until it reaches the point at which the machine proceeds in a series of spurts with intervals of complete stoppage between. Such conditions are, of course, unsatisfactory.

A rather complete system of predicting the conditions under which these actions occur has been developed by the scientists and engineers who deal with amplifiers and servomechanisms. The system, however, is rather involved, and requires a considerable amount of skill and labor to apply. Experience on actual applications so far has indicated that satisfactory response can be obtained with control parameters well within the stable range of operation, for those applications so far made. The chief objection to designing for stability in this manner is that a delay of several seconds is required before the effect in the change of an adjustment becomes apparent at the product. Higher product speeds, requiring greater response rates may intensify the stability problem.

This same characteristic leads to a difficulty in following periodic load changes such as are introduced by, let us say, an unbalanced roll. In certain speed ranges sufficient correction can not be provided at the required rate of speed, and the uniformity of speed suffers. This action can be minimized by selecting a good unit with little slip for the main power drive.

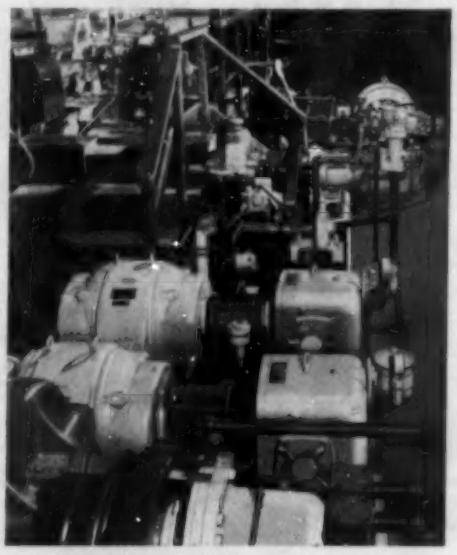


FIG. 4. FEEDBACK DRIVE installation on a paper processing line

Applications will continue to be made with considerable caution for some time. The labor involved in a preliminary analysis is so great, and the approximations required in determining characteristics so numerous, that the chances of a truly accurate prediction are small, and the effort can be justified only for extremely important or repetitive applications. The evaluation of probabilities of success in any specific instance must be made with judgment which can be obtained only by experience. It is therefore probable that for the present new applications will be made only in instances where a rather slow rate of correction will be acceptable.

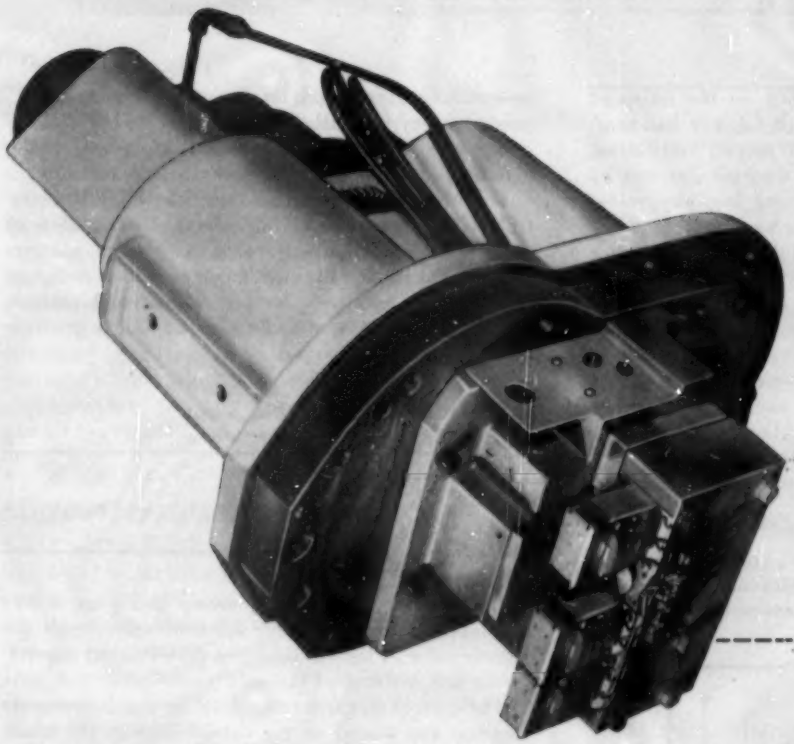
Even so, the simplicity, flexibility, ruggedness, and dependability of hydraulic drives will recommend their use in many places, and we can confidently expect to find a rapid increase in the bank of experience which will permit more accurate evolution of future problems.

This article has been prepared from a paper presented at the National Conference on Industrial Hydraulics, October, 1953.

HYDRAULIC CONTROL SYSTEM

. . . for 6-Speed Chucking Machine

● By R. C. Ebersold



SOLENOID actuated valves which control clutch engagement are mounted on the outside face of the transmission.

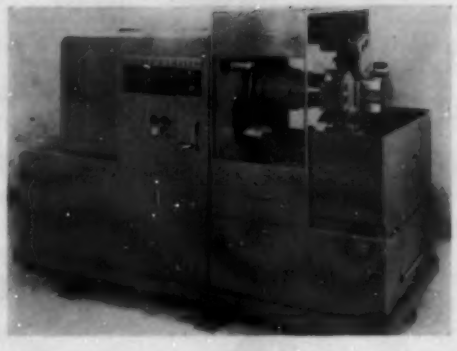
A RELATIVELY simple, compact six speed hydraulic transmission, developed for a line of single spindle automatic chucking machines, has been a key factor in the wide acceptance of such a unit by the metal working industries. Three solenoids, operating two-position valves can be used to control as many as eight separate functions. Seven of these functions are required and used for the control of the new spindle drive transmission which incorporates braking in addition to its six spindle speeds. Three solenoid-operated 4-way valves were combined into a circuit with a hydraulically operated shuttle valve to control these functions.

The new transmission utilizes constant-mesh gears with hydraulic clutches for speed selection as shown schematically in Figure 1. The lower shaft is coupled to a drive motor. The intermediate shaft has three speeds through three separate clutches, which, in combination with the upper pair of clutches, gives six output speeds. These automatic pre-selected speeds are available at the spindle of the machine in two ranges, high or low, by a manual gear shift.

This unit followed the pattern of its predecessor, a four-speed transmission, which consisted of four clutches arranged similarly to C2, C3, C4 and C5, but without C1. Positive lubrication of the plain bearings under the clutch gears was accomplished by connecting the pressure port of the opposing clutch to the oil groove of the bearing. See detail sketch, Figure 1. The gear and bearing of the engaged clutch have no relative motion as the gear and shaft are clutched together and rotate as a unit. The opposing clutch gear, however, has relative motion to the shaft and bearing due to the difference of the gear ratios and is supplied

R. C. EBERSOLD, Development Engineer, The Warner & Swasey Company, Cleveland, Ohio

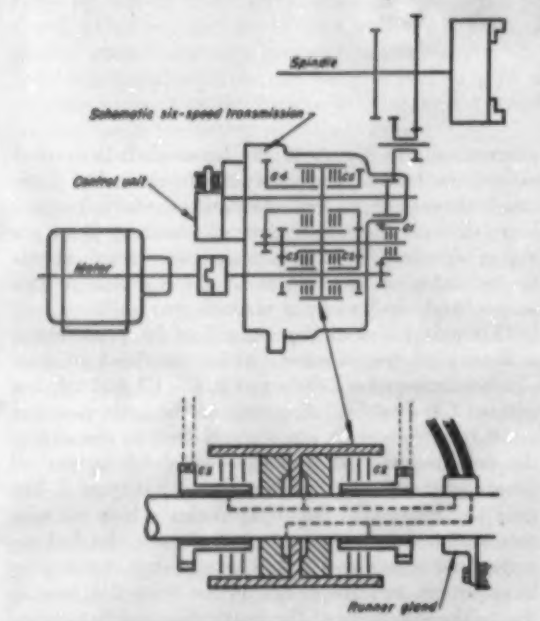
Compact six speed transmission on this single spindle chucking machine uses an electro-hydraulic circuit to engage and disengage clutches. Pressure control is provided by the design of a special pressure regulating valve.



with oil. This design was retained on the six-speed box with the exception that clutch C1 was ball-bearing mounted and did not require special lubrication.

The control of the four-speed transmission was by three conventional solenoid-operated four-way valves manifolded to a block which was separately mounted on the machine and required four connecting pipe connections to the transmission. A circuit diagram of this arrangement is shown in Figure 2. The additional function of the transmission, that of the spindle brake, is shown. The four-way valves are shown in their off positions (solenoids de-energized); the two upper clutches, C4 and C5, are energized through a separate reduced pressure circuit; the lower shaft with its connected motor is allowed to idle. The clutches, designed to carry maximum motor torque, are more powerful than required for braking. At normal line pressure, they brake the spindle abruptly, but at a reduced pressure of 60 psi a softer, cushioned brake action is obtained which still results in a fast stop.

FIG. 1. SCHEMATIC arrangement of a six-speed transmission for a single spindle automatic chucking machine. The detail shows the method of connecting runner glands to supply oil to each clutch.



The obvious alteration to this circuit for the control of the six-speed unit was simply the addition of another solenoid four-way valve. As pointed out previously, the three valves with two positions each can be arranged to give a total of eight combinations. These combinations, with "x" for one valve position and "o" for the other, are:

Table 1

Combination	1	2	3	4	5	6	7	8
Valve 1	o	x	o	o	x	o	x	x
Valve 2	o	o	x	o	x	x	o	x
Valve 3	o	o	o	x	o	x	x	x

On this basis, the circuit shown in Figure 3 was developed, using only three solenoid valves with the shuttle valve as shown, reducing the electrical requirements and the cost of the unit.

The control unit was taken from its previous remote location and placed on the outside face of the transmission, as shown in Figure 1. This made it possible to manifold the pressure lines to C4 and C5 clutches. The shaft runner glands of the remaining clutches on the lower and intermediate shafts were connected by flexible hose lines along the side of the transmission housing. The relief valves were also located in the control unit. This made a complete assembly; it is possible to remove this unit from the machine by simply disconnecting the solenoid leads, two hydraulic lines and the motor coupling.

The addition of C1 clutch presented a lubrication problem for the plain bearings of the lower shaft clutches. It was definitely possible that the machine could be operated for lengthy periods using only two spindle speeds, and if these spindle speeds were the combination of C4 and C5 clutches with the C1 clutch, the plain bearings of the C2 and C3 clutches would be without means of positive lubrication and subject to eventual failure.

From the circuit diagram, Figure 3, it will be noted that while clutch C1 is engaged, clutches C2 and C3 are connected to drains D2 and D4. This problem was

Table 2

VALVE POSITIONS are charted for each of the six speeds on the hydraulically actuated transmission.

SPINDLE DRIVE TRANSMISSION											
	SOLENOIDS			Shuttle valve	SPINDLE DRIVE CLUTCHES					SPINDLE SPEEDS	
										HAND SHIFT	
	SVA	SVC	SVB	SD	C1	C2	C3	C4	C5	LOW	HIGH
OFF	O	O	O	*	d3	d2	d1	X	X	BRAKE	BRAKE
SPEED 1	*	O	O	O	X	d2	d4	X	d3	39 RPM	82 RPM
SPEED 2	O	*	O	O	d1	X	d4	X	d3	64	134
SPEED 3	*	*	O	*	d3	d1	X	X	d1	108	280
SPEED 4	*	O	*	O	X	d2	d4	d3	X	178	378
SPEED 5	O	*	*	O	d1	X	d4	d3	X	292	622
SPEED 6	*	*	*	*	d3	d1	X	d1	X	496	1058

*=SOLENOID ENERGIZED — X=CLUTCH DRIVING
O=SOLENOID DE-ENERGIZED — d=DRAIN(TO RESERVOIR)

solved by connecting these drains to an oil sump. This sump receives oil from the spray ring fed by the oil discharged from the relief valve. The spray ring, a ⅜ inch tube in the top of the machine, lubricates all the sliding and rotating bearings of the machine through strategically located small drill holes. The oil sump was located at a point approximately three feet higher than the transmission shaft, giving sufficient pressure head to the trapped liquid to overcome the centrifugal force of the oil at the rotating shaft and stationary gland and positively lubricating the plain bearings of the clutches. However, the head was not high enough to develop sufficient pressure at the clutch pistons to overcome the piston springs and cause clutch drag.

CLUTCH PRESSURE CONTROL

The combination of oil from the spray ring and the leakage of oil at the runner glands and clutch pistons provides adequate lubrication for the anti-friction bearings and gears of the transmission. A 3 gpm pump is ample to maintain a working pressure of 125 psi. This pressure quickly energizes the clutches to provide snappy speed changes and to provide lubricating oil for the spray ring.

The relief valve, Figure 3, provides for the two required line pressures. The first pilot model of the new transmission was built with two separate valves, similar to the relief valves shown in Figure 2. The main relief valve of 125 psi capacity was placed in the line from the pump and a separate 60 psi relief valve was connected to line 9 to reduce the pressure for the brake function. With this circuit, check gauges in the lines showed that the pressure on clutch C4 was considerably greater than the pressure on C5. An examination of the circuit made it evident that during brake, the oil flowed across two control valves and through several passageways before being discharged at the 60 psi relief valve. Unfortunately, the resultant pressure drop in the circuit was located between the two clutches.

This brake condition had existed on the earlier four-speed transmission, but to a lesser degree and the pressure differential between the clutches was not considered serious.

On the new unit the pressure differential was gauged

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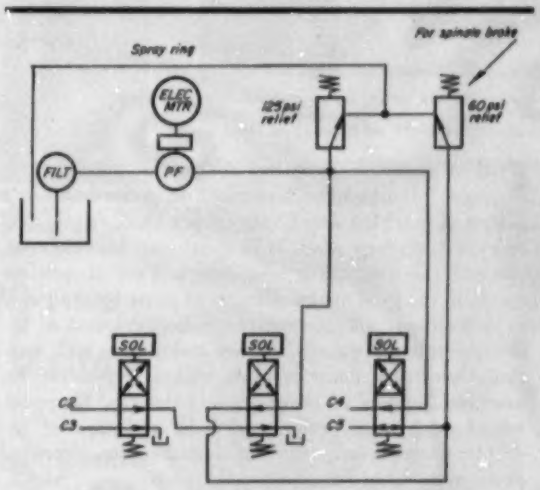
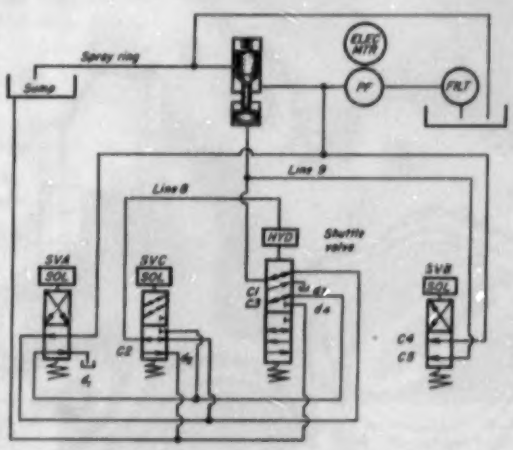


FIG. 2. AN INTERMEDIATE step in the development of the six-speed transmission using a separate relief valve for the spindle brake.

FIG. 3. THE FINAL arrangement of the transmission with drain from the driven clutches connected to an oil sump, the spray ring lubricator and the use of a single relief valve to balance pressure between clutches.



LOWER MACHINE COSTS

. . . with Circuit Redesign

By Harry Mortenson

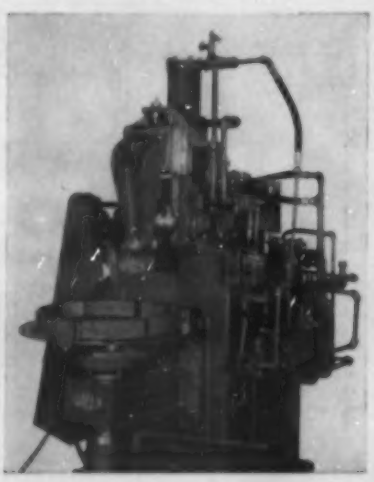
FOR a machine designer, it's never good to become permanently "married" to a method or a design. A machine which may be practical, economical or even ingenious when built today can become complicated and costly at a later date in view of developments in the field of the component parts incorporated in it. For example the continuous improvement of hydraulic valving, pumps, piping techniques and associated electrical controls often makes it possible for machine builders to simplify early designs. Reappraisal of established designs, in light of improved hydraulic practice, may result in simplification, improved performance and reduced maintenance.

An interesting case of such reappraisal of an early design is offered by the "Before and After" example of the Yoder Company's hydraulically operated tub beading machine. Many fabricators, throughout the country, who make washing machine tubs, use this beading machine to roll the bead or lip around the edge of the tub. The original machine was developed approximately 15 years ago and it has been duplicated a number of times in the interval since.

Several factors influenced the continuation of the original design. The principle factor was that since the tub beader is a special machine, it was not built in large quantities and cost of a redesign could not be supported until major design improvements and justifiable cost reductions could be made. Also the original machines performed very well for long periods of time thus improvement was not forced. However, increased labor rates eventually pointed out the

HARRY MORTENSON, Designer, The Yoder Company, Cleveland, O.

FIG. 1. ORIGINAL DESIGN *of the tub beader was made about 15 years ago.*



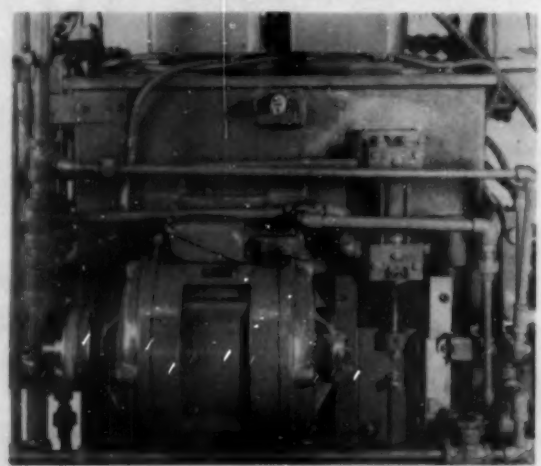
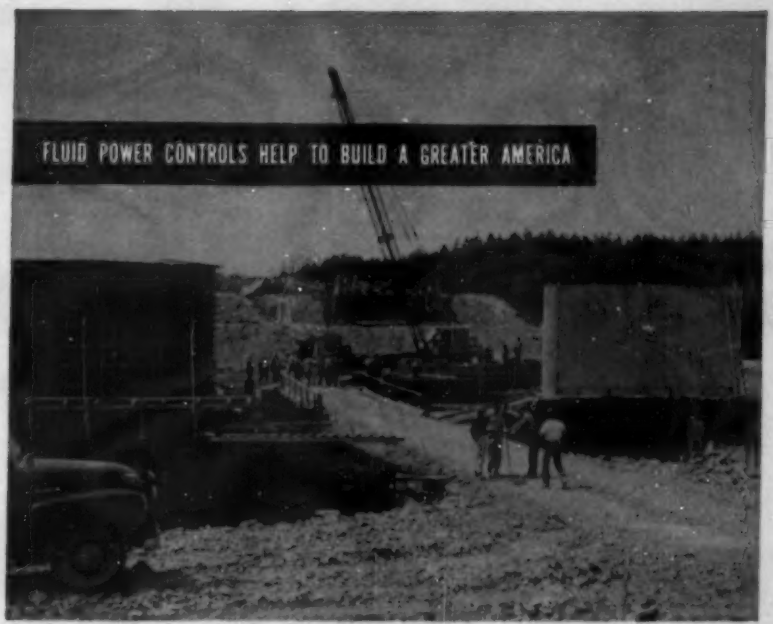


FIG. 2. HYDRAULIC COMPONENTS *on the original machine were mounted on the machine frame. The hydraulic reservoir and pump were located inside the frame.*



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high cost of building and maintaining the original circuits particularly the special valving which was required.

The original machine and a closeup of its hydraulic system is shown in Figures 1 and 2. Figure 3 details the original hydraulic circuit. When the design of this tub beader was first developed, solenoid operated hydraulic valves were relatively untried and not too readily available. It was necessary for the machine designer to develop a semi-automatic pilot control system which made use of pressure and cam operated valves. The final design was extremely successful; however, the use of cams to control the cycle had some inherent disadvantages. This difficulty could not be resolved simply until a better, more positive control means, such as electricity via solenoid valves could be applied.

A primary disadvantage of the early design, contributing to the cost of construction, was the five cams used on the original machine. Adjusting them to work properly was a difficult task which often delayed assembly. As labor costs rose, disadvantages of this design became more and more burdensome. It might be pointed out also, that the arrangement of piping to the various valves, necessarily located around the machine, proved costly by today's standards.

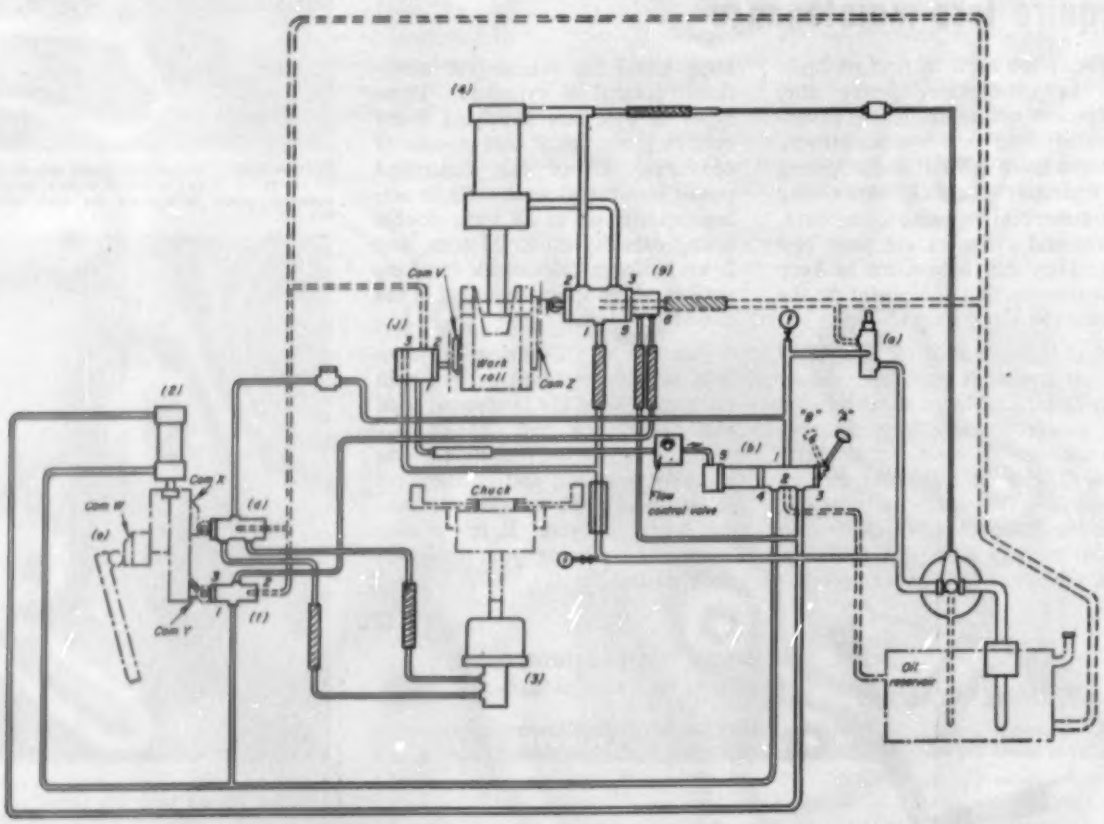
Redesign of the tub beader is shown in Figures 4 and 5. The new electrically controlled hydraulic circuit appears in Figure 6. Note that there is only one cam in the new circuit and all valves in the new circuit are standard. On the old design, several valves decidedly "special" were used. By meeting JIC standards, the new circuit has components which are readily accessible for maintenance; the power package is mounted separately from the machine; tubing with liberal radii and a minimum of fittings has replaced the original plumbing.

Oil power performs the same functions on both the old and new machines, operating the work clamp chuck and the clutch also applying the force to roll the bead.

On the old machine, the cycle is started when the handle on valve (b) is shifted from position (B) to (A), permitting low pressure oil to flow from port 1 to port 4 to the rod end of the clutch shifter cylinder (2). Cams (x), (w) and (y) move up. Cam (x) de-

Concluded on page 76

FIG. 3. BEFORE RELIABLE *electrically operated valves were available, this semi-automatic circuit was developed. The pilot control system uses pressure and cam operated valves. Although the design was successful, use of cams has some inherent disadvantages. Adjusting them to work properly is difficult and often delays machine assembly.*



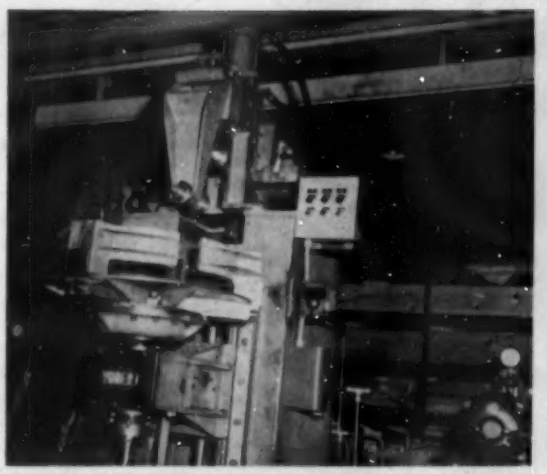


FIG. 4. THE NEW DESIGN *is built to JIC standards. Availability of reliable electrical controls permitted the elimination of cam controlled valves which were costly and difficult to adjust.*

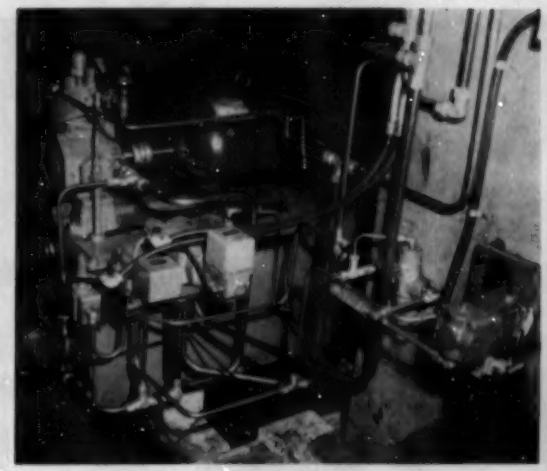
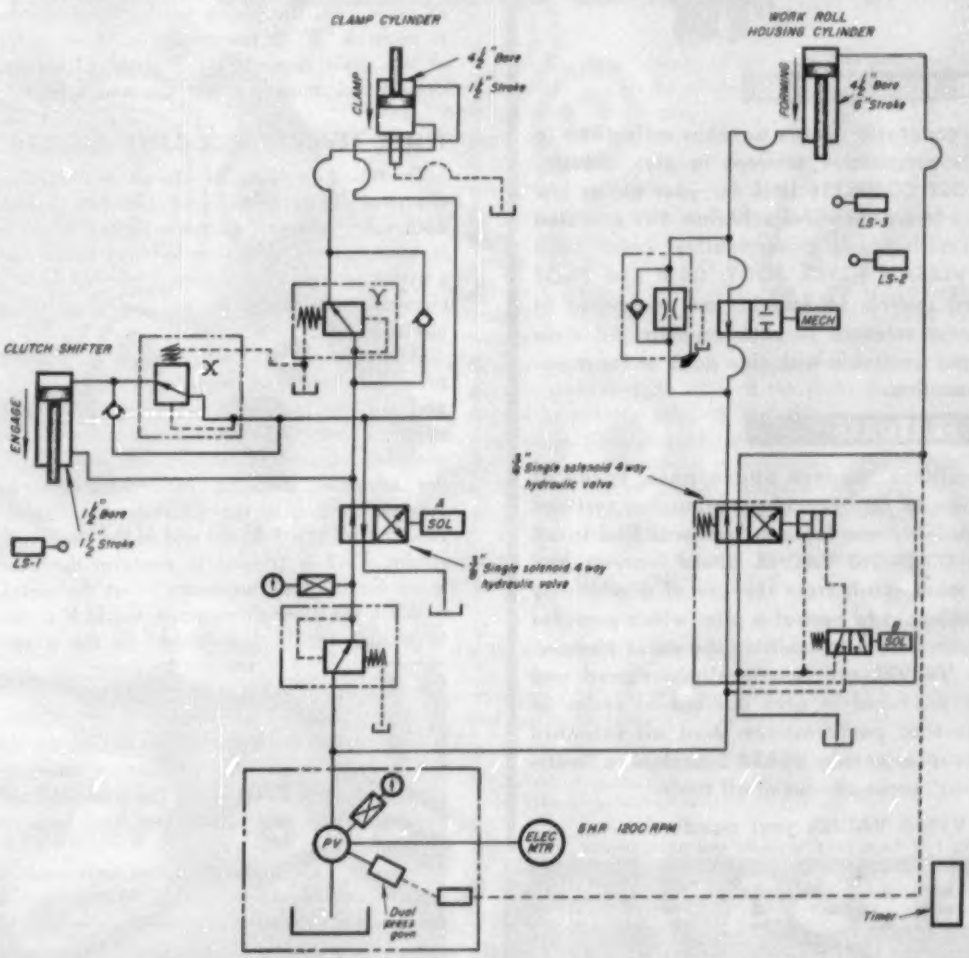


FIG. 5. ALL VALVES *on the new power package are standard. The power unit is now separate from the machine frame simplifying assembly and service. Tubing has replaced piping with screwed fittings.*

FIG. 6. USE OF SOLENOID *operated valves actuated by pushbuttons, limit switches and electrical timer gives reliability to the new machine circuit. Only one cam operated hydraulic valve remains in the circuit and this is a simple shut off valve to switch operation from rapid advance to feed. Sequence valves X and Y assure clamping before clutch operation and clutch release before unclamping.*



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Lower Machine Costs . . . with circuit redesign

Concluded from page 74

presses the roller on valve (d) permitting flow of low pressure oil to the chuck (3), causing the chuck to grip the work. Further travel of cylinder 2 causes cam (w) to engage clutch (E) which puts the tub in rotation.

At the end of travel of cylinder (2), cam (y) depresses the roller on valve (f) permitting low pressure oil to flow through ports 1 to 3 then to port 6 on valve (g). This pressure forces the roller on valve (g) to position "B". This permits high pressure oil to flow through valve (g) to the head end of the work roll cylinder (4). The oil will flow freely until the work roll meets the tub and cam (z) pushes the roller on valve (g) into position "A" to throttle flow and slow movement of the work roll.

When the work roll has reached the proper depth, cam (v) causes valve (j) to pass oil from port 3 to port 1 and then to port 5 on valve (b) which acts as a time delay for the shifting of valve (b). When oil has metered through an adjustable needle on the back of valve (b), the piston in the valve will be moved to position "B" to reverse the machine cycle. Success of this cycle depends on accurate adjustment of the cams which must position the hydraulic valves.

TIMER REDUCES VISCOSITY EFFECTS

Operation of the new circuit is controlled by an electrical circuit using limit switches to initate solenoid valve reversal. Accurate timing to set the metal is accomplished with an electrical timer rather than a hydraulic time delay which is affected by oil viscosity changes and cannot be as readily adjusted as the electrical timer.

After the tub is loaded, the cycle start button is pressed to energize solenoid A. The tub is clamped and sequence valve X opens to allow the clutch to engage. The clutch shifting mechanism trips LS-1 to energize solenoid B. As the work roll housing cylinder advances, the cam valve is depressed to slow forward motion to the forming rate controlled by a flow control valve. At the end of the work roll cylinder stroke, LS-2 is tripped to energize the timer which is set for the time necessary to set the metal.

When the timer times out, solenoid B is deenergized to reverse the work cylinder. As the work cylinder moves up, LS-3 is tripped to deenergize solenoid A. The clutch releases and after sequence valve Y opens, the clamp releases to complete the cycle.

Redesign of the hydraulic circuit on the tub beader has greatly simplified the circuit; standard components are used throughout; the assembly and adjustment problems created by cams have been completely eliminated.

Although the original circuit represents some excellent and ingenious designing and includes some ideas which may still have merit on modern machines, application of new developments has created a new and far better circuit for this machine.

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Better understanding of the application of oil hydraulics to production machine tools was the goal of these men who joined in an exchange of ideas and experience at the...

Machine Tool Hydraulics Forum

FOR a day and a half last month some 150 engineers, whose companies build and use hydraulically powered machine tools, met in Detroit to participate in a question and answer forum sponsored by Vickers, Incorporated. The discussion brought out developments in hydraulic components, circuit layout and maintenance procedures which would help to improve performance of oil powered machine tools.

Arrangements for the forum were handled by a committee chairmanned by Milton R. Fox, regional sales manager of the Vickers Detroit office.

Here are the highlights of the discussion presented at the forum.

CIRCUITS AND SYSTEM PROBLEMS

How many hydraulic power units should be used on a transfer machine?

On transfer machines where there are a number of work heads, transfer mechanisms and clamps powered from the same pump unit, B. Mikel of Chrysler's DeSoto Div., pointed out that pressure drops and surges cause trouble as individual heads move. As one solution to this surge problem DeSoto has installed 1 quart accumulators. It was pointed out that individual units would give positive control and would be easier to trouble shoot. It was generally agreed that the power circuit for work heads should be independent from the power circuit for fixtures.

If, for example, drill heads can be arranged to return together, it is practical to power all heads from the same pump. It was concluded that with proper design, several operations could be powered from the same pump. The indiscriminate use of individual units is costly in both space and money.

How to eliminate malfunction of pilot valves caused by backpressure in the drain line?

On machines having a group of pilot operated, solenoid controlled four-way valves, some cases of inad-

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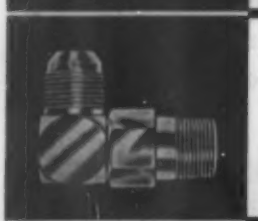

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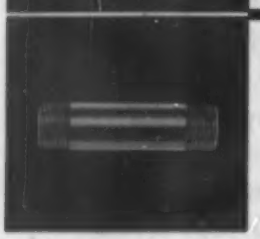

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MACHINE TOOL HYDRAULICS FORUM

vertent valve shifting have been encountered. In these cases, the drain lines have been long and tortuous enough to result in a drain line surge. While one solution to this problem is to return all drain lines separately, this is not always practical. To prevent drain line surge, the lines should be carried to a manifold header which is vented to atmosphere through a breather.

Gordon Swardenski, Caterpillar Tractor Co. and J. H. Mansfield, Greenlee Bros. were moderators.

Are more pressure gauge connection points necessary?

Discussion centered around the cost of supplying more test connections. Will the customer support "watchdogs on watchdogs"? Edward Rogers of General Electric briefly described a gauge disconnect fitting with a built-in check which has simplified their problems of using gauges. General opinion indicated that suitable test connections should be available, however, permanent installation of gauges at every check point did not meet with approval.

How to eliminate hydraulic shock?

This was a tough one to answer because each circuit requires tailored attention. Shock can be minimized by tapering the spool lands in valves and by using throttle grooves and progressive chokes. Reversing pump circuits with decelerating controls have proved successful on many machines. On machines where the shock wave exists, some success in absorbing the shock has been had by using accumulators or short lengths of high pressure hose.

What about operating hydraulic circuits at 3000 *psi?*

Don Morrell, of Ford, summed up the answers to this question with the comment, "Let's cure leakage at 500 psi before we go to 3000 psi." It was agreed that high pressure systems should only be used where there are definite gains to be had. Along with increased leakage problems, machine tool users have encountered difficulties with piping, control of throttle size for feeds and poor equipment life on high pressure application. There is a great amount of work to be done in the development and application of high pressure components.

Where should mechanical or hydraulic feeds be used?

Discussion of this question indicated that for heavy cuts hydraulic feeds are preferred, while for light cuts the choice is mechanical. Each system has its applications, separately or combined. It seems that the hydraulic designer is being challenged to provide a feed unit which will result in precise, consistent cycle time. Mechanical feeds increase machine cost particularly when variable speed control is needed. Also, it is difficult to use a mechanical feed against a positive stop. Paul Walla, Wright Aeronautical Div., Curtis-Wright Corp., told about one of their installations on which they combined mechanical feed with a hydraulic cushion to come up against a positive stop and to give rapid reverse. Fred Kampmeier, Ingersoll Milling Machine, said each application required analysis to make a choice. His company prefers mechanical feeds for long travels, for slow rates where no drift can be tolerated, and for climb cutting. Myer Fox, Lapointe Machine Tool Co. said their experience indicated less downtime with electrical and mechanical feeds. He felt that this advantage could be overcome by education of the user in the care of hydraulic systems.

MANIFOLDS

Why use manifolds? What types are available?

Ernest Seborg, Barnes Drill Co., detailed their experience with drilled manifolds made of aluminum and steel. The advantages of reduced maintenance, piping, and less line surge were stressed. C. G. Menard, Heald Machine Co., points out their use of sandwich type manifolds cast from meehanite for 200 psi service with flows to 400 fpm. On a 24 x 16 x 1½ in plate they grind to a .0002 in flatness. Feather edges of grooves are wire brushed to prevent particles from fouling valves.

Methods of fastening the sandwich type manifolds were discussed. There are bolted assemblies with gaskets for sealing. Hydrogen brazing has proved very successful and a third method was detailed by G. G. Brinkman of Ex-Cell-O Corporation. He discussed the cycle weld process which initially was used to bond automobile brake linings to the brake shoe. This process uses a thermosetting plastic cement to bond the plates. Manifolds fastened with this process are being used on 500 to 1000 psi systems.

Do users prefer standard valves mounted on a manifold or several valves built into one body to form the circuit?

A standard arrangement is easier to trouble shoot. Ed Lerczak, Oldsmobile Div., pointed out that while downtime with the standard arrangement may be more frequent it isn't as lengthy and is therefore preferable.

PUMP AND VALVE DESIGN PROBLEMS

What's the field record of solenoid valves?

Contamination from dirt was ruled the greatest cause of solenoid failure. Solenoid covers are removed and lost. Ford is chaining covers to the unit to prevent loss. Kurt Tech, Cross Company, said their circuits are being interlocked to prevent machine opera-

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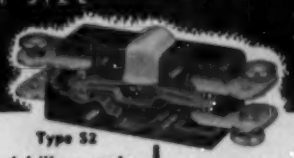

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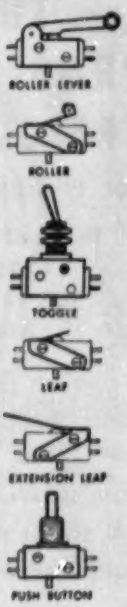

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tion unless the solenoid covers are replaced. Part of the solenoid failures are due to poor pilot action caused by backpressure in the drain lines. It was pointed out that for double solenoid valves, an electrical interlock is desirable to prevent energizing both solenoids at once.

How do valve springs stand up?

Their record is good. No one at the meeting recalled a case of spring breakage. The main trouble has been an inoperative spring caused by poor oil care which results in sludge and varnish deposits on the valve spool.

Should pressure operated valves be nonadjustable?

"Whenever you can eliminate an adjustment you have improved your machine," was Mr. Brinkman's comment. When machine operation permits nonadjustable valves—use them. In those cases where utility and economics leads to the use of adjustable valves, lock the settings to prevent tampering.

Can flow rate variations through throttle valves be prevented under changing oil temperature conditions . . . and under widely varying pressures?

It is difficult to supply a flow control valve which will be unaffected by changes in oil viscosity. Good results have been obtained with some valve designs, Mr. Menard told of one such valve.

As to flow control with changing loads, the pressure compensated valves works well—if the load does not change so rapidly that the compensator can't stop shifting.

FLUID MOTORS

Are machine tool spindles being driven by fluid motors?

Several companies, Bryant Chucking Grinder Co., Monarch Machine Tool Co., and Sundstrand Machine Tool Co., briefly described machines on which they use fluid motor spindle drives. Both piston and vane type motors are being used. From a cost standpoint, the fluid drive compares very favorably with a motor-generator drive at 7½ hp and above.

Discussion of speed regulation indicates that 2 to 3 percent is attainable with standard hydraulic transmission. Finer regulations can be obtained with feedback controls. Minimum speed depends on the circuit. Speeds down to 1 rpm are possible. In general, speed ranges from 50 to 3600 rpm are easily obtained without gearing.

FILTERING HYDRAULIC SYSTEMS

What type of filters are preferred?

Discussion on this question centered around the problem of selecting a filter which would not remove additives from the fluid. Robert Q. Sharpe, Socony-Vacuum Oil Co., said cellulose type filters prove very adequate. Removal of additives with activated clay filters depends on flow rate and the quantity of filtering material.

Are there warning devices to indicate that the filter element needs attention?

On a bypass filter, pressure gauges can be calibrated to indicate when the element needs cleaning or replacement. Some users are installing pressure switches in the suction line which act to cut out relays on the pump drive motor when the suction filter needs attention.

PETROLEUM BASE FLUIDS

Can specifications and terminology of comparable hydraulic oils be standardized?

J. C. VanGundy, Texas Company, expressed the opinion that it would be unwise to standardize on performance characteristics. Such standardization would stifle competition and hinder developments.

How do users determine when to replace hydraulic oil?

Many users replace oil when the neutralization number has reached a certain level. In general, one "measurement stick" is not a good guide. Replacement of oil should be done on a machine by machine basis. Appearance of the oil and odor are good warning signs which tell when a sample of oil should be checked. Oil suppliers will make this check for the user.

J. J. Yates of Detroit Diesel, described a record system which his plant uses to control oil replacement.

Most users, unfortunately, wait for trouble before oil is replaced.

Continued on next page

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With the introduction of an exclusive new oil-eliminating feature that prevents build-up of scum and sludge, Nicholson air traps now enable you to enjoy the advantages of the positive intermittent action of a float-operated air trap without the common problem of oil congealing on the mechanism and impeding or stopping its action. Other features of Nicholson air traps:

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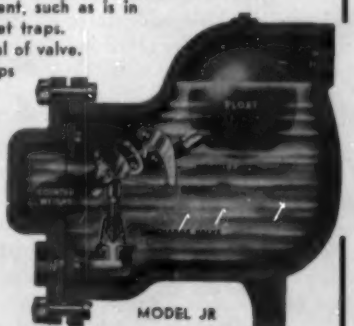

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MACHINE TOOL HYDRAULICS FORUM

What is the effect of excessive heat on mineral base liquids? What can be done to control temperature?

Mr. Sharpe pointed out that for every 20 degree rise in temperature the oxidation rate of the oil doubles. While this rate varies with different oils, it is agreed that at 140 F the oxidation rate is reaching a limit which will cause trouble with further temperature rise. Heaters can intensify this problem because of hot spots—if the oil isn't kept circulating, the heater can "cook" the oil.

Coupled with this heat problem is the operating efficiency of valves and cylinders. They will operate best at room temperature, 130 F is reasonable and 155 F is considered the maximum permissible temperature.

Temperature control largely depends on good circuit design since heat is caused by resistance to flow. Good machine layout which provides heat dissipation by convection and adequate reservoir size are important. Where machines are overloaded or adequate heat dissipation can not be provided due to space or other design consideration, heat exchangers with thermostatic controls will provide safe operating temperatures.

FITTINGS—TUBING—HOSE

What tubing should be used on hydraulic systems?

JIC standards recommend 1010 dead soft seamless steel. Mr. Morrell said that welded seam tubing has been tested in the laboratory with satisfactory results. After further tests welded tubing may be recommended when available.

How should tubing be tied down?

The more tie-downs the less trouble you'll have from fitting leakage caused by vibration. The trend appears to be toward the elimination of pipe thread connections.

What is preferred—flared or flareless tube fittings?

Users such as Ford, Allis-Chalmers, Fisher Body, and Caterpillar expressed preference for flareless fittings because they are more convenient for the machine repairmen. They claimed that proper flaring required machine made flares which present a problem in the field. On the other hand, Chevrolet-Buffalo, expressed satisfaction with 37½ degree flared fittings.

What's being done about pipe threads to minimize leakage?

Tapping a good thread seems to be the biggest problem. Some improvement has resulted from the use of the Dryseal thread form. James Robinson, Vickers, discussed a new thread form for hydraulic plugs which has given excellent results. This plug has a ⅞ inch per foot taper and is being made in a size range of ⅛ to 1½ inch. These hollow hex head type plugs do not have to be tinned.

There is a need for a fitting which does not depend on a thread for a seal. Fittings having straight threads and using "O" rings or bonded seals were discussed.

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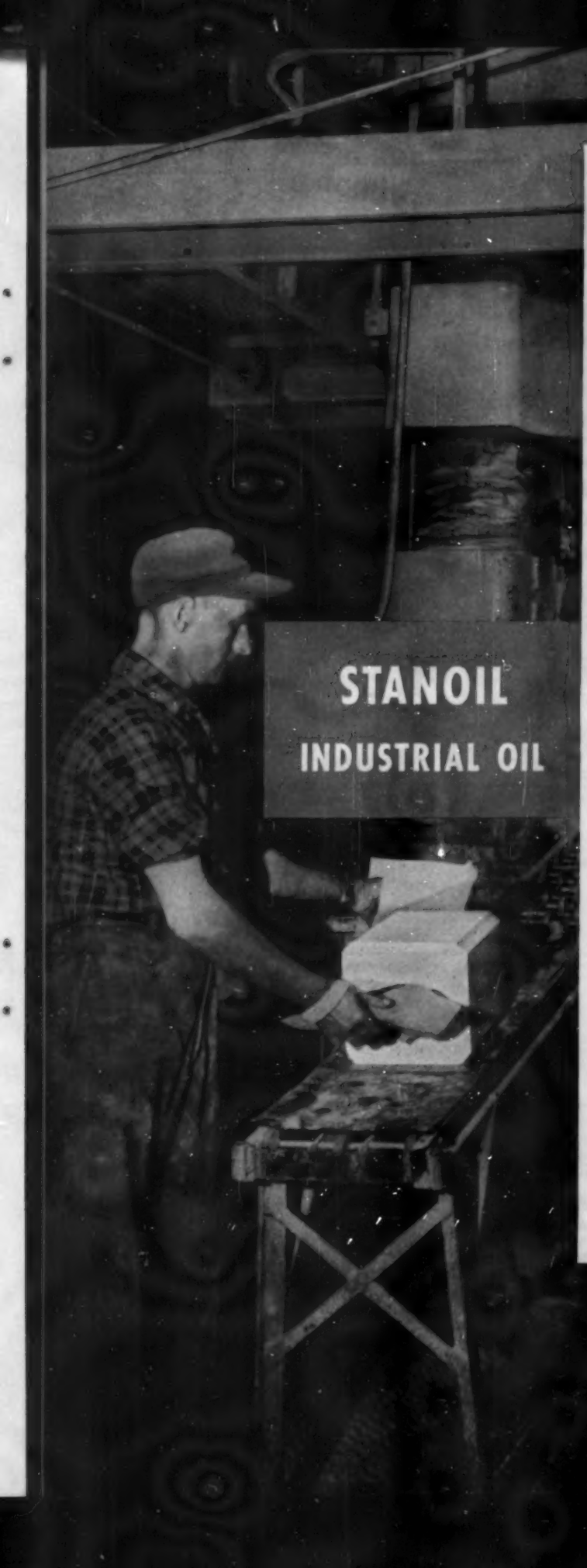

How a good oil earns its salt!

Here's a "salty" story about an oil with staying power. When this 100 ton hydraulic press was to be installed by the Morton Salt Company in their Manistee, Michigan plant, officials outlined to a Standard Oil lubrication specialist some of the rigid specifications the required oil should have. The new press would operate under a heavy load five days a week, and since the original fill would be large — 22 barrels — it was important that the oil installed resist oxidation and remain in good condition for long periods.

The Standard man recommended STANOIL Industrial Oil #25, a many-purpose oil having high stability and effective rust protection. In over seven years of hard service, the oil has never been changed! During this period, periodic tests of oil samples have shown that STANOIL, despite hard service and high oil-operating temperatures, has maintained a lubricating quality comparable *with a new oil.*

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HYDRAULICS · PNEUMATICS

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SWIVEL FITTINGS

. . . for aircraft hydraulic systems

By Michael Tarasewich

EVER since the early formation of principles in the mechanics of fluids, we have inherently been encumbered with the problem of providing suitable conduit for directing this energy. An additional related problem was that of transferring fluid across points of relative motion. Obviously, this was solved by the use of flexible couplings.

Three basic types of flexible couplings are available. Any of these may be used in combination with each other. The types are:

(1) Flexible Hose—rubber, synthetics, metallic braid, etc.

(2) Flexible Tube—Straight, torsional and helical coil

(3) Rotary Joint—Plane and universal

Although it may sound paradoxical, the flexible tube and the rotary joint may be considered as flexible rigid couplings. However, all three, which serve the function of providing a passage for the transmittance of fluid, play as vital a part in the successful design and operation of hydraulic systems as the more admired complex components. It is reasonable to assume that the above listing represents a preference in the aircraft industry in the order given from both a practical and economical point of view. There are instances, however, when the sole use of flexible hose would not be feasible. In such cases, we must yield to another form of coupling.

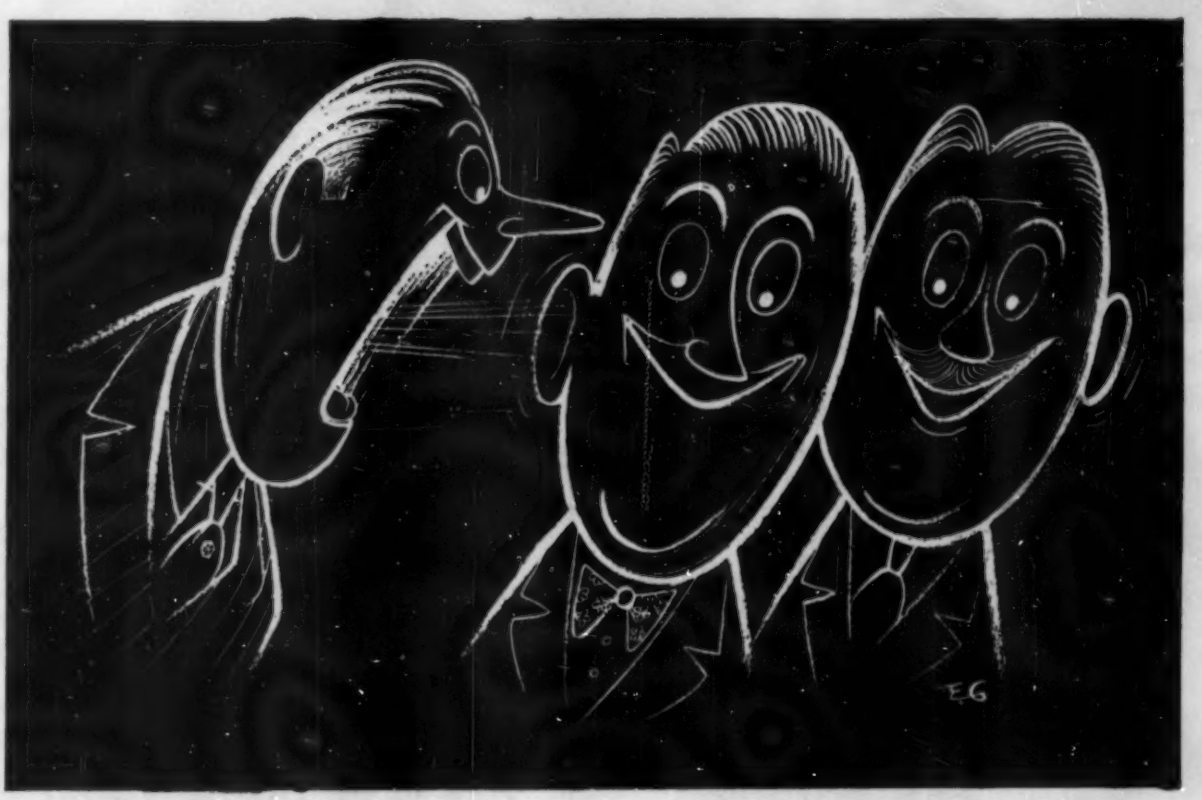
Due to appreciable success in service, standardization of design and promising techniques for greater improvemept, we have been led to use the rotary joint, both independently and in combination with other flexible couplings in approximately thirty percent of our applications. We shall primarily be concerned with the rotary joint, which will be arbitrarily called swivel.

Why Swivels are Used

There are several factors that may influence the designer to use swivels in lieu of flexible hose. These may be one or more of the following:

(1) *Space Limitation*—Where operating geometry of a hydraulic service makes it impracticable to use hose, e.g., to prevent chaffing which ma,

MICHAEL TARASEWICH, Grumman Aircraft Engineering Corporation



What's all this talk about PNEUMATICS ?

Men like George Medhurst were talking — and doing something about pneumatics years ago. As early as 1800, Mr. Medhurst took out patents in England for a pneumatic automobile! But today, the brightest future for pneumatics is in the field of aviation. It's easy to see why, when you look at the tremendous advantages of pneumatic systems for aircraft.

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We here at Kidde are constantly on the watch for new applications of this exciting force. We think it fortunate that we were among the first to explore this fascinating field.

Perhaps you, too, are investigating this power of tomorrow. If you have any problems in pneumatics, write us.

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possibly affect safety of flight in the event of failure, swivels are used.

(2) *Location*—Where adverse service conditions may be encountered, e.g., deleterious oils, chemicals, fumes, temperatures, submersion, etc.

(3) *Rigidity*—For decreased breathing and improved response conditions. These would include servomechanisms, acceleration restrictors, boost and powered circuits and other critical systems.

(4) *Storage Life*—Where indefinite service life is required. With swivels the limitation is that of the packing life. Packings should be readily available as they should be the standard used throughout the hydraulic system.

The space limitation, presumably, dictates the present use of swivels in aircraft hydraulic sytsems. Nevertheless, it should be borne in mind that the converse may also be true. Operating geometries or locations need not be penalized because hose alone is considered. The advantages of improved performance and appreciable weight savings which swivels offer are very important factors in aircraft.

Types of Swivels

If any classification were to be given to swivels, they would be as numerous as there are types. However, for our purpose, let us tentatively type them as fixed, semi-fixed and floating assemblies; the nomenclature describing the application rather than the design. We shall be limited to swivels that rotate in one plane, which, in combination with any of the above listed couplings can be made to accommodate cylinders with reasonable deviations, thus simulating the self-aligning feature of the universal joint.

The illustrated swivels (Figures 1 to 7) are comparable to those being used in current aircraft. Figures

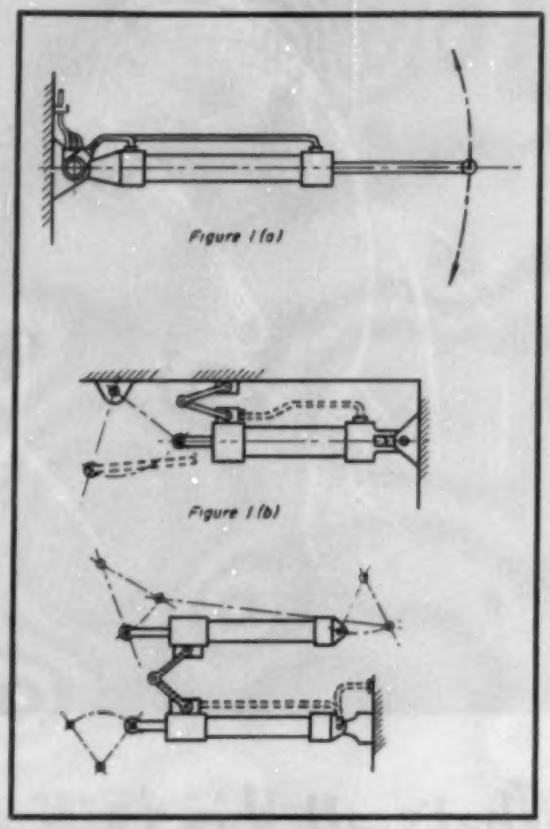
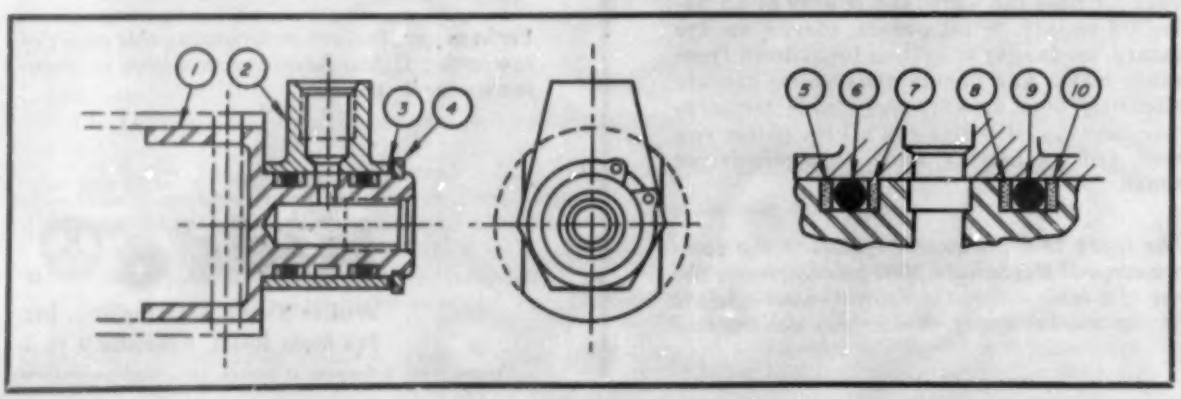


FIG. 1. SHOWS TYPICAL (a) fixed; (b) semi-fixed; and (c) floating type of swivels. The fixed type is so-named because the pivot is fixed with respect to the structure and is on a common axis with the rotatable hydraulic device. With the semi-fixed type (b), one pivot is fixed, the others remain free to move. In the floating type (c) the entire swivel assembly is free to move. This is a theoretical installation, usage appears remote. All swivels are of the pressure balanced type.

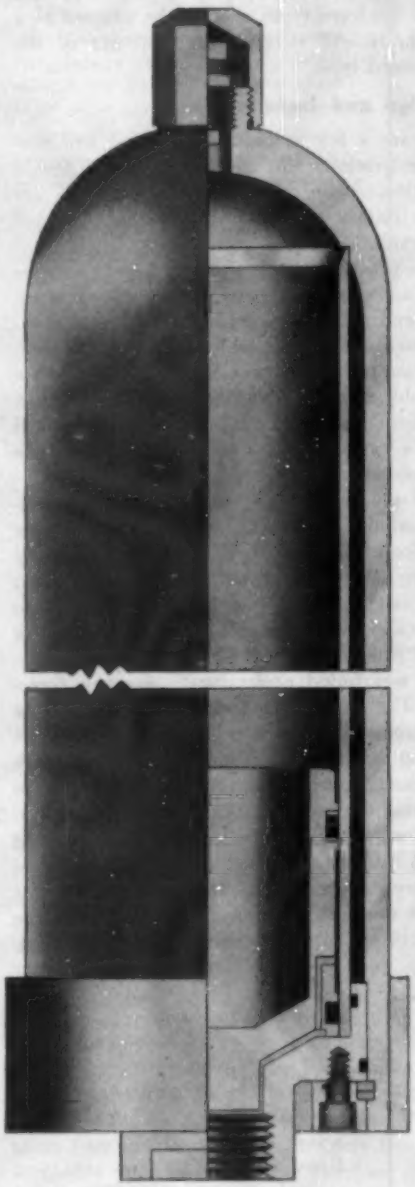
FIG. 2 ON THIS SIMPLE single-line swivel, (1) is the inner body, (2) is the outer body, basic machine parts of most swivels. The inner body is fixed to the structure by a through bolt. Any mounting technique (thread or flange) consistent with good design practice can be used. Part 3 is a washer, part 4 the standard NAS-51 type snap ring. Cross-section at right details the swivel seals. Standard AN 6227 "O" rings (6 and 7) are extensively used in 1500 psi systems and, in combination with back-up rings (5, 7, 8 and 10), in 3000 psi aircraft hydraulic systems. Back-ups 7 and 8 are usually incorporated to prevent inadvertent interchange of "O" and back-rings during reassembly of swivels in service.



Superior

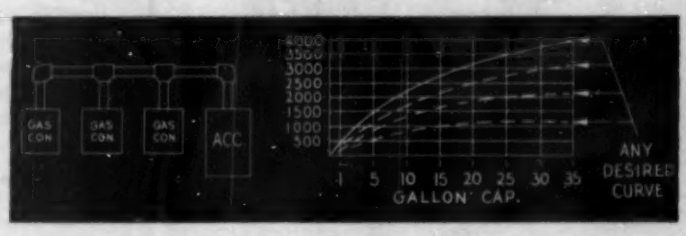
ACCUMULATORS

AVAILABLE FROM 5 CU. INCHES TO 8640 CU. INCHES



The SUPERIOR Accumulator makes available to industry a floating piston type cylindrical unit designed to provide maximum service life. The double shell construction employed in this design provides a pressure balanced inner shell containing a piston as a separator between the precharge gas and the working medium. The outer shell acting as a gas container and a protective cover insures that damage inflicted to the outer shell through rough handling will not interfere with the free movement of the piston. Rapid decompression of the precharge gas, resulting from rapid discharge of the working medium, provides a coolant around the entire working area of the inner shell, thus, the accumulator temperature is at the lowest possible level.

The piston, constructed with two standard 'O' rings has pressure balancing ports to provide equal pressure to either side of each ring, reducing the tendency to extrude and further eliminating the possibility of pressure lock between 'O' rings. A dash pot is provided to decellerate the piston travel effecting a gradual cessation of movement preventing the tendency to hammer at the end of the stroke, thus, the entire swept volume of the unit can be available for work. Spiral Teflon non-extrusion back-up rings is an added design feature that reduces friction and wear, resulting in maximum service life at minimum maintenance cost. Specify SUPERIOR Accumulators in your designs and be SURE of uninterrupted production performance.



Manifolding auxiliary gas containers to the accumulator enables the design engineer to accomplish any desired predetermined pressure curve.

Superior

HYDRAULICS DIVISION

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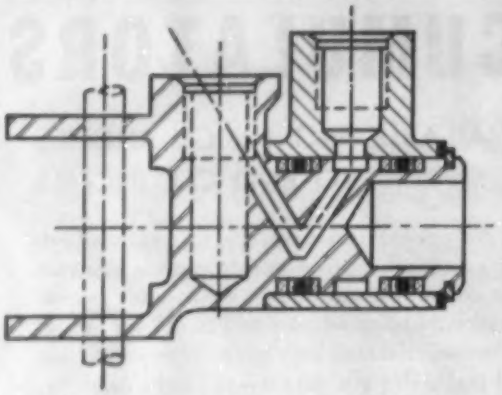
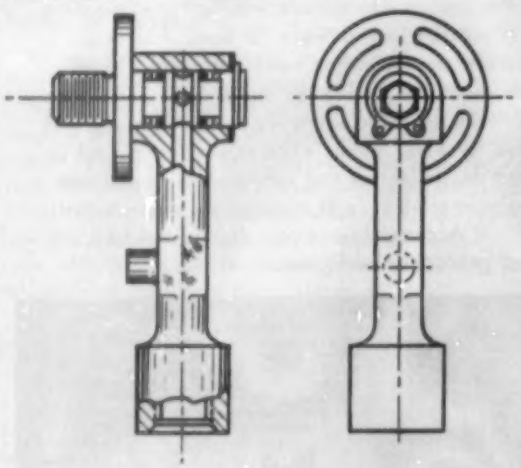


FIG. 3. THIS IS AN alternate design of Fig. 2. The arrangement of ports is parallel rather than perpendicular as in Fig. 2.

FIG. 4. STILL ANOTHER version of the single-line swivel for extremely close space installation. The inner back-up rings have been omitted. In such cases the casing should be conspicuously marked to indicate proper location of rings. Inner body is used as a union fitting with "O" ring and designed to be threaded into a feed-through structure; fastening is accomplished by two lock-wired screws through crescent openings in the flange.



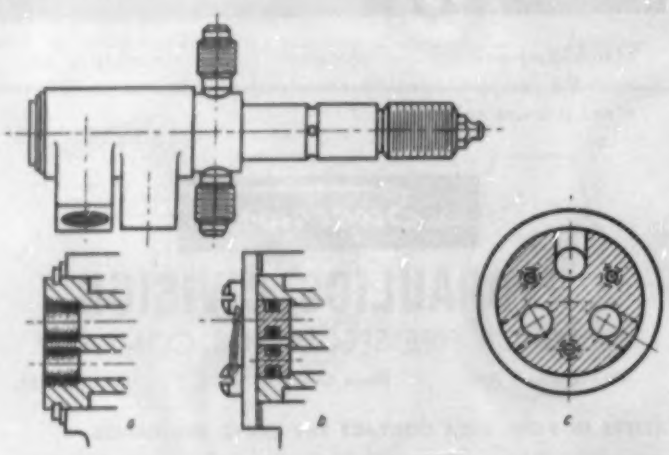


FIG. 5 TYPICAL EXAMPLES of the two-line (a and b) and three-line (c) swivels. Detail (a) shows a male fitting brazed as part of the inner body. Sealing end plugs are also copper brazed. Cylinder mounting bolt is integral with inner body. If female ports are desired, standard "O" rings may be used, as in detail (b). This eliminates brazing. Detail (c) shows a sectional end view of a three-line swivel inner body with holes drilled radially to intersect the inner passage to complete the conduit for each groove.

2 to 5 inclusive illustrate examples of the fixed type swivel; Figures 6, the "trombone" and 7, the "nutcracker" are the semi-fixed type. These possess greater freedom than the fixed types and can be adapted to a floating assembly. All swivels described are of the pressure balanced type.

Swivel Design and Installation

Following are a few successful, practical and economical considerations with regard to swivel design and installation. Detail dimensional references are omitted since the seal grooves are the standard grooves used in hydraulic cylinders.

(1) Where practical, choose the minimum number of swivels to accomplish the operation. This will minimize weight and reduce machining costs.

(2) Standardize the inner-body diameter to accommodate at least two tube sizes. The inner-body flow passages would, therefore, be determined by the flow requirements of the largest tube size used. This will make possible various swivel assembly combinations when multi-line swivels are designed.

(3) Separate multiple-line swivels where advantageous on installation. For example, on a particular amphibian aircraft a total of six lines were necessary to be routed to the landing gear strut. These lines were: two normal landing gear lock cylinder lines; two emergency lock cylinder lines; and two brake lines, one of which was emergency. Of the various possible combinations, it was found preferable to use two three-line swivels. The reason was to make an identical or reversable assembly, which was economical from the manufacturing point of view and for stocking spare parts and, most important, to permit isolation of the emergency from the normal lines for efficient installation. If one swivel was damaged by debris during water taxiing with extended gear, the circuit would not be rendered inoperative.

(4) Where multiple-line swivels are used, combine pressure and return circuits with each swivel to mini-

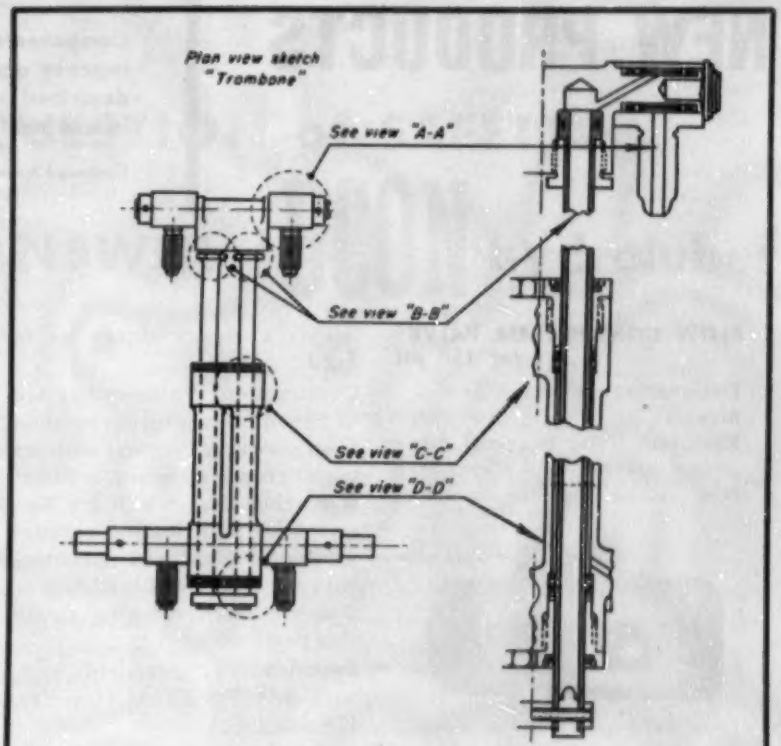


FIG. 6 THE "TROMBONE", a two-line swivel, is basically two individual swivels connected by tubular links. As displacement is accomplished by sliding tubes a third pivot point is unnecessary. The pressure balanced tubes protrude through the body. Detail A-A shows basic swivel configuration of inner and outer-body machining. Multipiece construction for small sizes is shown. Detail B-B shows the mechanical joining of tubes to body. Detail C-C shows port openings for sliding tubes and scraper rings to remove foreign matter from tubes. Detail D-D shows end port design with tube plugs. Pressure balanced tubes never bottom on the end stop; the latter is an advantage during bench testing, preventing inadvertent separation by mechanic while swivel is under high pressure.

mize the maximum torque that can be applied. With increasing use of teflon as back-up rings, this consideration becomes negligible. Teflon, in addition to being impervious to most acids and solvents and having a wide temperature range, has a low coefficient of friction. If it is desired to impose no bending moment on the tubes, a bracket may be fastened to the swivel and rotating structure.

(5) Study the circuit installatiors so that any failure causing interflow would not be detrimental to safety in flight. It is advisable to show all swivels on flow diagrams.

(6) Follow basic hydraulic assembly practice. Before assembly, clean all parts absolutely free of chips, grease and dirt. Caution must be taken to select perfect "O" rings and to prevent damage to them during assembly. Back-up rings, if leather, should be immersed in hydraulic fluid for approximately five minutes immediately prior to assembly. The face of the leather back-up ring with the smooth appearance (hair-side, outside skin or grain side) should always be installed facing the "O" ring.

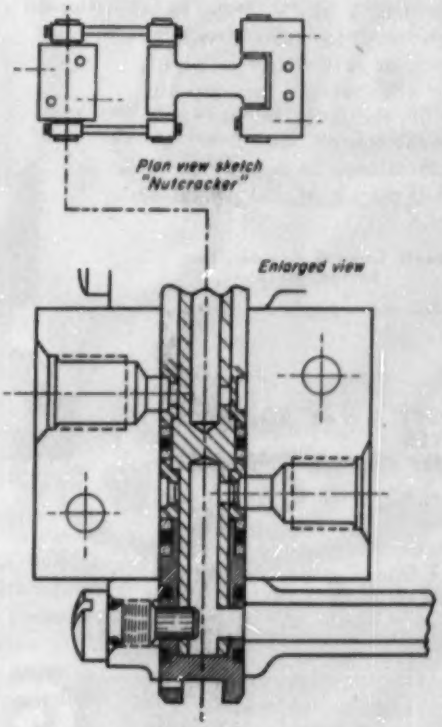


FIG. 7. THE "NUTCRACKER", a two-line swivel, is basically three individual swivels connected by machined links. Flow passages are sealed against external leakage by standard "O" and back-up rings (indicating 3000 psi design). The enlarged sectional view shows a multi-piece assembly for very small swivels where difficulty may be encountered in stretching an "O" or back-up ring during installation. Larger size swivels do not require multi-piece construction.

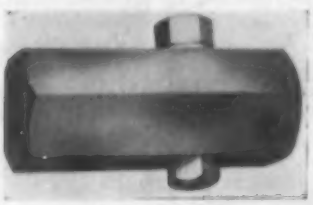
NEW PRODUCTS

Components, tools and equipment designed to improve operation of fluid power systems are described here . . . for more information fill in and mail the post card bound in this issue.

Continued from page 28

FLOW CONTROL AIR VALVE . . . for 150 psi

Designation: Model 3620
Size: ⅛ in
Features: Valve to meter, flows in one direction and allows free flow in the opposite direction.



Features an anodized aluminum body and a nylon poppet. The corrosion-resistant adjusting screw has a slotted hex head which may be turned with a wrench or screw driver. Tightening the nut on the opposite end of the adjustment screw locks the setting.
Specifications: Is recommended for 150 psi air or 300 psi oil or water.

Rivett Lathe & Grinder, Inc., Boston, Mass.

Circle 165 on Reader Service Card

MIDGET 4-WAY SOLENOID VALVES . . . for double-acting cylinders

Designation: Bulletin 8345 Valves
Design: Permissible pressures range from a minimum of 10 psi to a maximum of 125 psi for AC and up to 50 psi for DC. Pipe size is ¼ in; orifice diameters are 1/16 in inlet, 3/32 in exhaust. Power consumption is 10 watts. Valve is designed for handling air, water, light oil and other non-corrosive gases and liquids at temperatures up to 212 F.
Construction: Valve bodies are of forged brass insuring freedom from porosity. Packless with integral crown seats and resilient and nylon discs which are best suited for tight seating requirements. All metal parts in contact with the fluid are either brass or stainless steel, reducing corrosion possibilities.
Specifications: Standard voltages are 115 or 230 AC 60 cycles, 115 volt DC.
Applications: Primarily for controlling small double-acting cylinders. Also used to control two single-acting cylinders where

pressure must be alternately applied and exhausted. Such combinations of pilot valves and cylinders are used for operating large valves and dampers, and on types of automatically controlled equipment.

The Automatic Switch Company, Orange, New Jersey

Circle 166 on Reader Service Card

CONSTANT SPEED ELECTRIC MOTORS . . . totally enclosed

Designation: Klosd-Tite
Features: Totally enclosed, fan

cooled constant normal speed motors. These new, smaller motors incorporate the New National Electric Mfg. Association (NEMA) approved standards. Have a compact streamlined drive which are fully protected and excel in performance and durability. Some of the features are, more horsepower in less space, heavy duty ball bearings, stator windings of advanced design and new terminal boxes.

Sterling Electric Motors, Inc. Los Angeles 22, Cal.

Circle 167 on Reader Service Card

PRESSURE REGULATOR . . . is flow sensitive

Design: Responds to the flow of oil entering it in such a way that the relief valve setting decreases as inlet flow decreases. Because of this feature, a fixed displacement hydraulic pump will not stall when the input torque is reduced below that value required to meet the setting of an ordinary fixed setting pressure relief valve. Accordingly, an emergency hydraulic system can

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the ANSWER *is* UCON hydrolubes

Trade-Mark

"What are Ucon hydrolubes?"

Ucon hydrolubes are Carbide's water-base safety hydraulic fluids.

"Why do Ucon hydrolubes contain water?"

Water is the key to their non-flammability. Actually, Ucon hydrolubes are balanced formulations of water, a synthetic lubricant, an anti-freeze, and selected additives. As long as the water concentration is maintained, Ucon hydrolubes *stay* non-flammable.

"Are they water emulsions?"

No, the special synthetic lubricant in Ucon hydrolubes is completely soluble in water.

"How do Ucon hydrolubes affect wear in my machines?"

Special anti-wear agents in Ucon hydrolubes provide satisfactory pump life and performance characteristics—as shown in more than 6 years of routine use in a variety of industrial hydraulic equipment.

"Will Ucon hydrolubes damage the metals in my machines?"

Ucon hydrolubes contain effective liquid and vapor phase corrosion inhibitors for protection of metals including steel, aluminum, brass, and copper.

"Can I continue to use the same kind of packings and seals?"

Yes. Ucon hydrolubes have no harmful effect on standard packings and seals.

"What about leakage?"

Leakage losses are often lower than with regular hydraulic fluids.

"How do I go about changing over?"

Drain the old fluid from the system, follow the cleaning procedure that Carbide recommends, and refill with Ucon hydrolube.

"What are the viscosities of Ucon hydrolubes?"

200, 300, and 550 S.U.S. at 100°F. Other viscosity grades can be supplied to fit specific requirements.

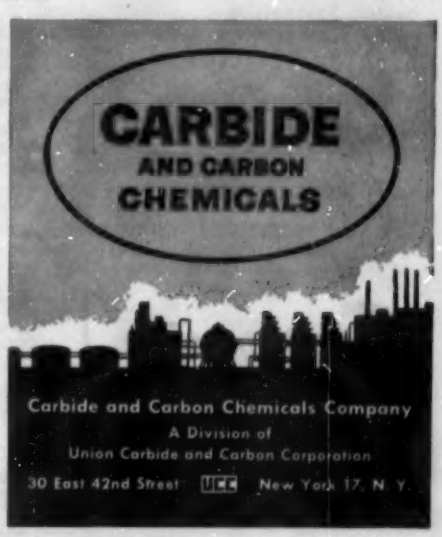
"How do temperature changes affect the viscosity of Ucon hydrolubes?"

Ucon hydrolubes have high viscosity indexes (150 to 160), and low pour points (below —55°F.).

"Are they safe to use?"

Yes, Ucon hydrolubes can be considered non-toxic for all practical hydraulic purposes.

✻ *If you have questions—or would like to know more about* Ucon *hydrolubes—write today for the booklet,* "Ucon *Hydrolubes*" *(Form 7380). In Canada: Carbide Chemicals Sales Company, Division of Union Carbide Canada Limited, Toronto.*



"Ucon" is a registered trade-mark of Union Carbide and Carbon Corporation.

Continued

always depend on an instantly available flow of whatever pressure the power source is capable of producing. Although a 3000 psi hydraulic system may deteriorate to 500 psi or less, total power will not be cut off merely because a conventional 3000 psi relief valve has stalled the pumping source.

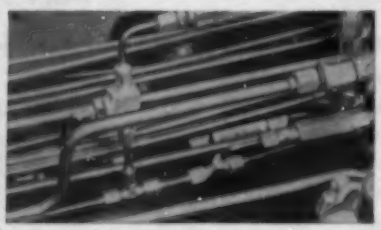
Applications: The pump for an emergency hydraulic system in

an aircraft may use a battery driven electric motor as its power source or perhaps a ram air turbine. As the battery charge is used up, a point is eventually reached where the hydraulic pump will stall. Although some power may remain in the battery, the torque demanded by the pump to meet a high, fixed, hydraulic relief setting will not permit use of the residual battery power. When ram air to a turbine falls below a certain value, a fixed pressure auxiliary hydraulic system would stall the turbine.

Vickers, Inc.,
Detroit 32, Mich.
Circle 168 on Reader Service Card

EVERYTHING YOU NEED IN LOW CARBON STEEL HYDRAULIC TUBING

Hydraulic carbon steel tubing in standard outside diameters from ⅛" to ½" is stocked by Superior distributors for shipment without delay. Your tubing distributor will be glad to quote you prices and delivery—and help you select proper tubing for your particular application. Please use the coupon below.



For more efficient than pipe, Superior tubing is the modern fluid handling circuit. Proper tube fittings offer tighter joints resulting in leak-proof systems. Smooth interior and sweeping bends mean less back pressure and internal friction. Freedom from these handicaps means greater over-all safety in operation.

The bending qualities of Superior Hydraulic tubing permit long, gradual bends and close radii bends where conservation of space is needed. The smooth exterior permits uniform contours and neater bends. Tubing is furnished in dead soft annealed temper #1 which offers desired strength properties and ease of fabrication.

Each lot of Superior tubing gets the flareability test required by the new SAE specification for carbon steel hydraulic tubing. A section of tube approximately 4" long is expanded over a mandrel having a 60° angle until the inside diameter is increased 30%. Each lot is also hydrostatically pressure tested.

Non-aging carbon steel hydraulic tubing is now produced to a new SAE specification. Available in lengths up to 28 feet, with the high physical and mechanical properties obtained by cold drawing, it offers better workability than ordinary steel tubing. Sizes from ⅛" to 1⅜" O.D. are available—with wall thicknesses that permit internal working pressures ranging up to 9,000 psi.

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MEASUREMENT GAUGE . . . has pistol grip

Features: The gauge is used in tool making and by inspection departments to measure "O" ring grooves, deep holes, tapers, recesses, inside spherical radii and out of round areas. Will accurately measure to .0005 in but

even closer readings may be checked. Dial gauge mounted is calibrated in half-thousandths. The measuring tips made of hardened gauge steel are actuated by pressing down the control lever with the thumb which contracts them while inserting in the hole or recess. By release of the lever, the tips expand and record the dimension of the location being checked. The gauge offers continuously variable id measurement from .250 in to 2.000 in with standard tips. Special tips provide extreme depth penetration and larger measurements; also for snap ring grooves. It is fully adjustable, and self centering. The body is of cast aluminum.

Mueller Laboratory,
Monrovia, Cal.
Circle 169 on Reader Service Card

LIMIT SWITCH
. . . is hermetically sealed

Design: Consists of a standard basic switch protected by a durable, sealed housing with integrally mounted actuator. All

joints are copper brazed. Electrical leads are imbedded in a glass-to-metal header providing a positive leak-proof seal to the connector. The patented teflon and silicone diaphram is bonded in place by a mechanical seal retainer providing a perfect seal but still permitting complete flexibility of the actuator. All vital components are sealed in an inert gas.

Features: The hermetically sealed unit was formerly an exclusive development for aircraft use. Now it is available for general industrial applications. Because of the absolute seal, lubricating oils, hydraulic oils, hydraulic fluids coolant, dust and dirt cannot cause a malfunction in it's operation. It is extremely resistant to terrific heat and sub-sub zero cold. Remains operative when completely immersed in water or coated with ice.

Electro-Snap Switch & Mfg. Co., Chicago, Illinois

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"LEVEL EYE"
. . . checks liquid level

Designation: Level-Eye

Feature: A unique "eye" has been developed to check inside pressure sealed systems for liquid level, gas-liquid ratio, cleanliness of liquid and operation of sealed valves and linkages.

Applications: Suitable for installations on tanks or piping systems operating at temperatures

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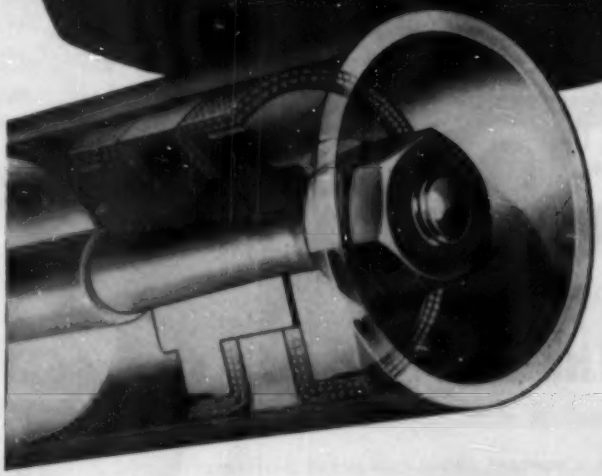

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First, texture-engineered Pumcups outlast most other piston packings at least 3 to 1. There's less replacement, less down-time!

Secondly, efficiency *does not diminish* as Pumcups wear. Response is always faster, surer, with less power consumed!

Darcova Pumcups are available in sizes and engineered textures ideal for virtually any service. Why not find out what they can save *you?*

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PUMCUPS

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between –50 and 250 F and at hydraulic pressures to 300 psig. Special units are available for higher pressures. For very low temperature systems a lucite frost shield is inserted over the glass "window" to keep it frost free. The shield may be easily removed for cleaning without disturbing the pressure seal.

Basically, a heat tempered glass lens with a series of concentric reflecting prisms on the liquid side of the glass, the unit reflects light where there is no liquid behind the glass causes it to appear black. This prism-type lens has definite advantages over transparent types since it is not fouled by oil and dirt in the liquid and does not require a second lens for illumination. It it suited for detecting level

where the range of liquid movement is not more than the diameter of the lens.

H. A. Phillips Co., Chicago, Illinois

Circle 171 on Reader Service Card

PRESSURE Monitor . . . gives calibrated readings

Designation: Norwood Controls 5AC

Design: A pressure monitor designed to give accurate, calibrated readings of any dynamic pressure.

Construction: May be set to

read in percent of full scale of transducer output or directly in psi. Either procedure may be used with the EP pickup but percentage readings should always be used with other transducers. The instrument contains a plug-in, two stage amplifier. The self-contained DC bridge power supply eliminates power frequency interferences. The amplification is 100 with high degenerative feedback.

Applications: Can be used with any two or four arm strain gage transducer and standard oscilloscope. Designed to take advantage of the accuracy, frequency

Seal it with

GOSHEN O-RINGS

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If you have a concern about leak-proof performance, seal it with Goshen O-rings . . . and forget it. Made from natural, synthetic, and silicone rubber compounds . . . to MIL, AMS, and commercial specifications, GRC O-rings are designed to withstand a wide range of conditions; air, water, oils, aromatic fuels, gases, refrigerants, ammonia, heat, cold, pressure and vacuum. What's more, they're available in a complete range of AN, MS, SAE and JIC standard sizes, as well as in many non-standard sizes and special shapes.

So, seal it and forget it . . . with "fit for the job" Goshen O-rings

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Twelve pages of information on sizes, groove dimensions, application data. Designed to help in obtaining efficient sealing for most every type of application.

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Protects hydraulic circuits

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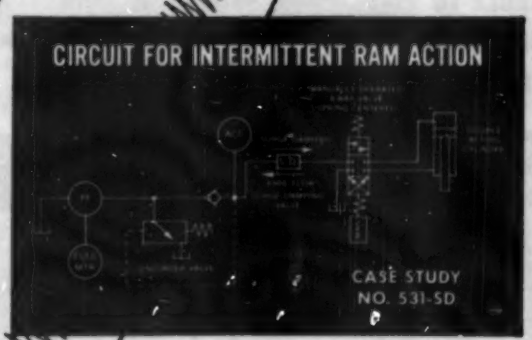

Denison Surge Damping Valve prevents hydraulic shock... eliminates damage to fittings, lines, seals and equipment

Sudden starting, sudden release of high pressure into a low pressure area, or reversal of flow causes a hydraulic surge as damaging to a circuit as blows from a hammer.

The Denison Surge Damping Valve converts the hydraulic surge into a smooth, gradually accelerated flow of fluid power. A hydraulically unbalanced reaction flow control in the valve causes the valve to open slower as the intensity of the surge increases.

Lightweight and easy to install, the Denison Surge Valve can be used on any circuit up to 5000 psi. Requires no adjustment . . . interferes in no way with the efficiency of the circuit.

The circuit shows a Denison Surge Damping Valve preventing hydraulic shock when stored-up energy in an accumulator is released. For a bulletin on the surge valve, write to: THE DENISON ENGINEERING COMPANY, 1166 Dublin Road, Columbus 16, Ohio.

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response and resolution of the model EP pressure pickup.

Control Engineering Corporation, Norwood, Mass.

Circle 172 on Reader Service Card

BELLOWS VALVES
. . . for corrosive applications

Designation: 440 Series
Size: Pipe sizes available are

⅛ to ½ in, with ¼ and ⅜ in Swagelok tube ends.
Design: Arc-welded bellows assembly of 18-8 stainless steel. Tests show this assembly capable of withstanding more than 100,000 cycles, at low pressure, in non-corrosive service. The valve body is constructed of 316 stainless steel, with Teflon seat and gasket. Both seat and bellows assembly are replaceable.
Features: Provide a low leakage rate across the seat and into the valve. Another advantage is a back-seating feature, especially useful in corrosive fluid application, in event of a bellows rupture.
Applications: For highly corrosive conditions, high vacuum work and mass spectrometry.

Hoke, Incorporated, Englewood, New Jersey

Circle 173 on Reader Service Card

AIR TRAP
. . . ejects water automatically

Designation: F3030
Construction: Light weight; all

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★ FLEXIBLE HOSE ASSEMBLIES

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★ DEPENDABLE SERVICE

★ QUALITY PRODUCTS

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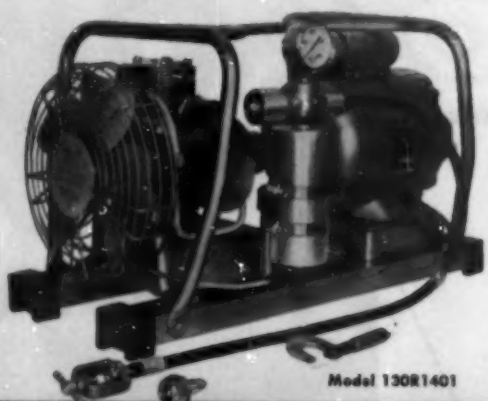
NEW

3000 PSI AIR COMPRESSOR AVAILABLE TO HYDRAULIC DESIGN ENGINEERS



Model 130R1401

FOR PRESSURIZING HYDRAULIC ACCUMULATORS AND AIR RECEIVERS

Cumbersome and wasteful nitrogen bottles no longer restrict applications of high pressure pneumatics in the industrial field. Where a definite requirement exists the Cornelius Air Compressor can recompress nitrogen to 3000 PSI.

The Cornelius 3 stage Air Cooled Air Compressor—capacity 2 CFM—provides clean air at pressures to 3000 PSI for pressurizing hydraulic accumulators, air receivers, and pneumatic actuators. Entire assembly Model 130R1401, illustrated above, including 1 H.P. heavy-duty AC electric motor, weighs only 79 pounds.

Cornelius PORTABLE AIR COMPRESSORS

WRITE FOR PRODUCT SHEET NO. 5

We invite your inquiry and shall be pleased to send you complete details.

THE CORNELIUS COMPANY
560 39th Ave., N.E. • Minneapolis 21, Minnesota

parts are non-corrosive and the needle type valve has a renewable seat which is easily replaceable. No special tools are required for installation or maintenance.

Features: This device is a float type water ejector which auto-

matically discharges accumulated water from any pneumatic system. Although it is usually piped directly into the bottom of an air line filter bowl, it can be applied to a drain line at any place in the pneumatic system. Dry air is assured at all times regardless of humidity or other contributing factors. Water is automatically discharged upon the accumulation of 3 to 4 ounces and complete discharge is accomplished within 5 seconds dependent upon line air pressure. Each unit has a capacity up to 20 gph. A sump is provided for periodic cleanout of dirt.

The Industrial Equipment Division
American Injector Co.,
Detroit, Mich.

Circle 174 on Reader Service Card

PRECISION LIMIT SWITCH
. . . completely sealed

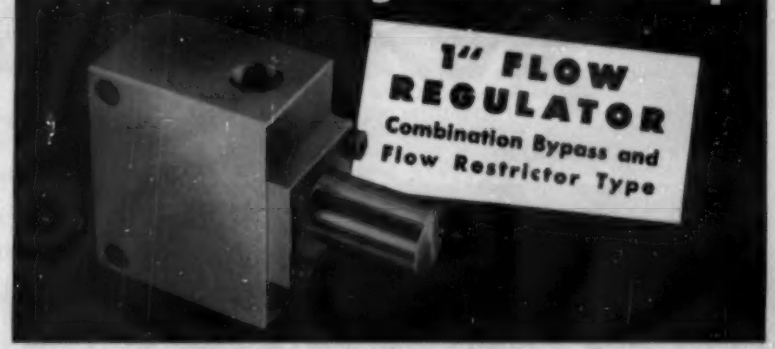
Designation: 51MLI

Capacity: 20 amp 110, 220 or 440 volts a-c, ½ amp 115 volts d-c; ¼ amp 230 volts d-c; ¾ hp 110 volts a-c; 1½ hp 220 volts a-c.

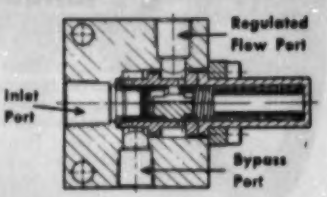
Construction: The switch's entire housing, including the operating head with its actuator and return mechanism, is sealed. All moving parts and contacts are protected from wear, clogging and corrosion. Die cast enclosure also provides complete

Circle 46 on Reader Service Card

Add A Regulated Circuit Without Adding Another Pump



- **Preferential control circuit can be used for POWER STEERING or other CRITICAL OPERATION**
- **Bypass flow is available for balance of the system**
  - For Oil Pressures to 3000 P. S. I.
  - Non-adjustable — specify flow desired
  - Regulated flow ½ to 25 G. P. M.



Write for detailed engineering data and prices.

Manufacturers of Hydraulic Valves and Devices

Fluid Controls, inc.

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Clamping Valves
Small Spring Loaded Accumulators • Special Valves

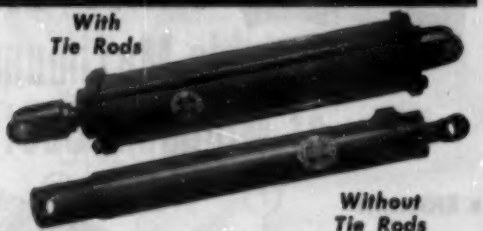
1284 N. CENTER STREET • MENTOR, OHIO

INDUSTRIAL CYLINDERS

Air Hoist

Famous Cross ruggedness makes this the most dependable air lift for specific overhead application.

With Tie Rods



Without Tie Rods

Depend on Cross heavy-duty construction for long-life performance. Available in 3-, 4-, and 5-inch bore size, plus other standard smaller bore sizes.

Air Hydraulic Cylinder

Cut installation and design in machine tool and clamp application. Choose 2-, 3-, 4-, and 5-inch bore.

Write for further details, prices, specifications, and professional advice on particular applications.

NAME_____

ADDRESS_____

TOWN_____ STATE_____

CROSS MANUFACTURING CO.
LEWIS PHONE 81 KANSAS

Circle 15 on Reader Service Card

AUTO-DIESEL offers 4 Features

1. QUALITY Piston Rings
2. in SMALL RUNS
3. at ATTRACTIVE PRICES
4. Make PROMPT Deliveries

It is not necessary to pay a high price for a short run of piston rings. Auto-Diesel have specialized since 1921 in making quality rings in small quantities and selling them at ATTRACTIVE PRICES. We are set up for this kind of business and have developed efficient methods that enable us to turn out quality rings, economically. Can make up to 35" diameter for original equipment and for replacement in compressors, hydraulic cylinders, valves, etc. We also make circular parts to your specifications. Write for prices.

AUTO-DIESEL SCRAPER RINGS AN 6231 .1 to 71

are PRECISION MADE and LONG WEARING

Auto-Diesel Bronze Scraper Rings are precision made by men who have specialized in work of this kind since 1921. For that reason they are LONG-WEARING and will reduce down time to the minimum. Can supply sizes from ½" to 13" I. D. Auto-Diesel Bronze Scraper Rings assure longer life of components used with pistons. We make rings and circular parts for jet engines. Write Auto-Diesel Engineers regarding any piston ring problem.

Write for Details

THE AUTO-DIESEL PISTON RING CO.
3137 Superior Avenue • Cleveland 14, Ohio
"RINGS and SHAPES Since 1921"

YOUNG HEAT EXCHANGERS
Provide Maximum Heat Transfer at Minimum Cost

- Efficient
- Lightweight
- Compact
- Rugged

Design Features

1. Smooth inlet and outlet flow bonnet.
2. Light and strong die-formed header.
3. Engineered baffle-spacing.
4. Precision parts prevent by-passing.
5. Non-ferrous shell and tube bundle.
6. For vertical or horizontal mounting.

Young Heat Exchangers provide maximum heat transfer at minimum cost. They are designed for any kind of fluid to fluid cooling for a variety of chemical and process applications under maximum operating pressure of 75 psi and temperatures up to 300° F.

Manufactured in a complete range of sizes, single and multi-pass, fixed tube and removable tube bundle, the units are built of ferrous or non-ferrous metals. Write for Catalogs 1049 and 1149.

Distributors in all principal cities. Check classified listings in your phone book; if not listed contact Racine, Wisconsin, direct.

YOUNG RADIATOR CO.
Heat Transfer Products for Automotive and Industrial Applications. Heating, Cooling and Air Conditioning Products for Home and Industry.
Dept. 400-U • RACINE, WISCONSIN
Factories at Racine, Wisconsin and Mattoon, Illinois

New Products

Continued

protection for the replaceable switching unit.

Application: Heavy duty, it is designed for use on all types of industrial equipment where dust, dirt, abrasives or liquids may be present. May be mounted in al-

most any position in relation to the means of actuation. The operating head is easily adjustable to any of four horizontal positions and the roller may be reversed on the arm. The roller arm may be adjusted to operate clockwise, counter clockwise or in both directions and the actuator arm assembly is adjustable through 360 degrees to any of 870 different positions.

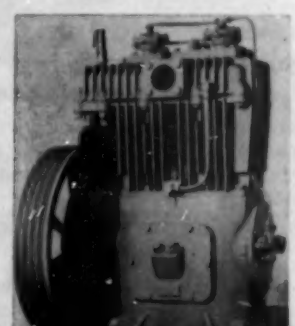
Micro Switch, a Division of Minneapolis-Honeywell Regulator Co. Freeport, Illinois

Circle 175 on Reader Service Card

AIR COMPRESSORS
. . . continuous pressures to 350 psi

Designation: Models 255 and 360

Features: Both models are equipped with new safe-Q-lube which, (when the unit is



equipped with "loadless starting",) automatically unloads the compressors when the lubricating oil level is low. Safe-Q-

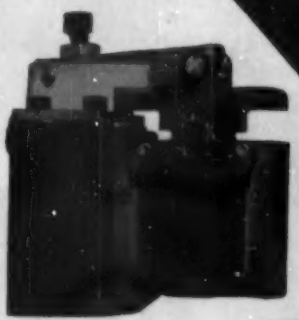
FOR

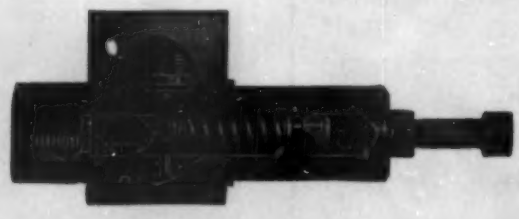
SAFETY, CONTROL

- POSITIVE ACTION
- LOW MAINTENANCE
- UNLIMITED ADAPTION
- CONTROLLED REGULATION

SOLENOID VALVES

SOLENOID VALVES for working pressures to 3000 psi. Designed for remote control of hydraulic systems, and handling non-corrosive fluids. Poppet construction eliminates leakage. Impregnated coils are oil and moisture resistant. Available in 100-220 Volt A.C.





CHECK VALVES

CHECK VALVES One piece construction—no welds to crack. Nylon Poppet assures leak-proof service. Light weight aluminum body. Low pressure drop. Available in 3/8", 1/2", 3/4" and 1" NPT line sizes.

ADJUSTABLE FLOW REGULATORS

ADJUSTABLE FLOW REGULATORS for cylinder speed control over a 50% range for pressures to 3000 psi. Meets requirements for cylinder speed adjustment yet maintains constant speed regardless of work resistance or pressure fluctuations.

For Machine Tools—Farm Equipment—Packaging Machinery—Steel Mills—Refineries etc. Four sizes: 1/4", 3/8", 1/2" and 3/4 inch. Overall length 4 1/2 to 7 1/2 inches.

UNLOADING VALVES

UNLOADING VALVES for system pressures to 3000 psi. Flow rates to 30 G.P.M. Fast acting, easily adjustable, maintain desired pressure settings without continuous readjustment. Hardened poppets eliminate leakage. Large passages assure maximum flow with minimum pressure loss.

Waterman

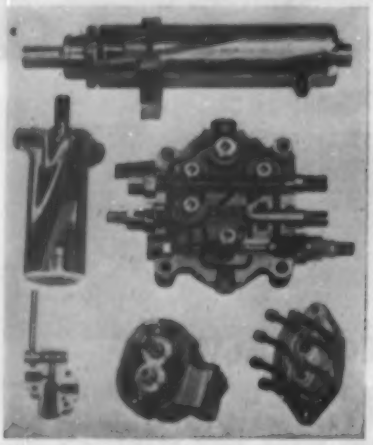
Write for our illustrated circular A

ENGINEERING COMPANY

725 CUSTER AVENUE • EVANSTON, ILLINOIS

HUSCO®

PUMPS
VALVES
CYLINDERS



"Husco" manufactures many standard and special hydraulic control units which include:

Hydraulic Cylinders—all types
Control Valves—capacities to 30 GPM—3000 PSI
Lever Operated Check Valves
Reciprocating Valves
Rotating Swivels
Check Valves
Package Power Units

"HUSCO" CUSTOM BUILT HYDRAULIC CYLINDERS

Complete lines of single-acting and double-acting cylinders, differential type, as well as telescoping cylinders, are available. All cylinders are built to customer application requirements. "HUSCO" cylinders are:

(1) Designed to insure concentricity of guides which are piloted from the same diameter

(2) Adequately guided to prevent any bearing load against the packings—insuring full life of packings and safe-guarding against leakage

(3) Provided with an adjust nut for take up on the packings

"HUSCO" welcomes the opportunity to provide engineering assistance on hydraulic problems and in developing new hydraulic equipment

Used on:
Construction, Industrial, Material Handling and Agricultural Equipment

HYDRAULIC UNIT SPECIALTIES CO.
Pumps • Valves • Cylinders
Waukesha, Wis.

lube also operates the "loadless starting," which can be added to those models already in the field. Other new features include pressure oil spray to main bearing.

Specifications: Model 255 is a single stage duplex cylinder with a 4½ in bore and 3½ in stroke. Maximum piston displacement is 58 cu ft and maximum continuous pressure is 100 psi. The new Model 350 is a two stage compressor with a 6 in and 3¼ in bores and 3½ in stroke. Maximum piston displacement is 51 cu ft. Maximum continuous pressure is 200 psi and 350 psi intermittent.

Quincy Compressor Co., Quincy, Illinois
Circle 176 on Reader Service Card

SOLENOID DIRECT LIFT VALVE

. . . for 5000 psi

Design: Coils used on normal pressures ranges are single

wound, higher pressures use double wound coils with two separate windings, a strong primary winding for initial pull-off and normal winding for holding the armature in the coil field during operation.

Construction: A stainless steel solenoid direct lift valve, has high corrosive resistance. Valve bodies are constructed of 305 stainless steel, solenoid armature is 416 stainless.

Specifications: Pressures are 5000 psi to 150 F maximum, 2500 psi to 400 F maximum. Orifice sizes range from 1/16 to 3/16 in dia depending on pressure requirements and coil used. Paper wound or glass impregnated coils are used depending on tem-

For a
MONEY-BACK GUARANTEE
OF LONGER SERVICE
specify
PROMET
THE Engineered BRONZE
BEARINGS-BUSHINGS
WEARING PARTS

Sold only under a rigid guarantee of superior and satisfactory service or a refund of the purchase price upon return—the customer's opinion to be final.

Available in standard and special formulas developed to cope with specific or unusual conditions. Assure the best combination of physical properties, strength in tension and compression, hardness, and ability to sustain both static and dynamic loading.

Protect the shaft or other moving parts from injury, scoring, and seizing due to temporary interruption or failure of lubrication, and at the beginning and end of a run when the speed of rotation is insufficient to maintain the oil film.

They will not powder under the most severe conditions of service. Available rough cast or machined to precisely controlled tolerances. They can be machined at surface speeds up to 875 lineal feet per minute.

Castings to your patterns—any size, shape or section—delivered as scheduled and specified. Pattern making, designing and machining when required.

Write today for free literature and service data sheets. Send blueprints, conditions of operation and other data for recommendations and quotations. You are invited to discuss your bearing problems with our metallurgists, engineers, and laboratory technicians.

THE
AMERICAN
CRUCIBLE PRODUCTS CO.
"Bearing Specialists Since 1919"
1303 Oberlin Avenue
Lorain, Ohio, U. S. A.

PACKAGED HYDRAULIC POWER!

This compact unit, comprising 'Electraulic' axial plunger pump and motor, control valves and oil supply tank, is supplied complete and ready for installation. Just bolt down and couple up three pipes! The unit illustrated develops 15 H.P. at 7000 p.s.i., and is arranged to control the speed and direction of all operations.

ELECTRAULIC
REGD. TRADE MARK

HIGH SPEED PUMPS
DIRECT HYDRAULIC SYSTEM

TOWLER BROTHERS (PATENTS) LTD., RODLEY, Nr. LEEDS, ENGLAND

Sole Agents: U.S.A. and Canada.

MACMILLIN ENGINEERING CORPORATION

2125 HOWARD STREET, CHICAGO 45, ILL. Ambassador 2-1191

• Since 1926 • In the application, design and manufacture—pumps, separators, hydraulic accessories.

EQUIPMENT FOR FLUID POWER TRANSMISSION

What's your problem?

- higher pumping speeds?
- tolerance of particle-laden liquids?
- peak suction for primary pumps?

the Kraissl-50 Roller Pump

Is unmatched for dependable performance on every one of these counts.

Bulletin A-1330 has full data . . . write for it. The roller-rotor design easily handles particles that would jam more tightly-fitted mechanisms—reduces cavitation, allowing higher speed operation*—develops high suction characteristics.

*Roller mechanisms permit higher speeds with any oil than most displacement designs.

KRAISSL CO

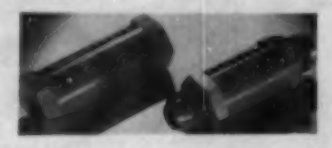
305 Williams Ave., Hackensack

perature range. For use on temperatures in excess of 180 F, glass wound, silicone impregnated coils are recommended.

Athomatic Valve Company, Indianapolis, Ind.
Circle 177 on Reader Service Card

HYDRAULIC CHECK VALVES . . . have fast opening

Designation: CIS and CIT
Design: Valves of the CIS series are of the cone type design with J.I.C. flared tube connections



which mate with Triple-lok sleeve and nuts. Valves of the CIT series are of the in-line cone type design with internal pipe thread connections. There are five models in each series.
Applications: Can be used on all hydraulic systems operating at pressures to 3000 psi. May be mounted in any position, and have been designed for fast opening and delivery of full line capacity with minimum pressure drop. Offer absolutely tight checking. Their special precision fabrication and sturdy construction enable them to withstand the mechanical shock of continuous action of the poppet against the valve seat.

Industrial Hydraulics Division, The Parker Appliance Company, Cleveland 12, Ohio
Circle 178 on Reader Service Card

DEHYDRAFILTER . . . for pneumatic equipment

Designation: Model CM-1
Design: Consists of a head and case in which the desiccant cartridge is inserted. Compressed air from the supply source enters the unit, flows downward around the outside of the cartridge and

Telephone ERIE 2-3664

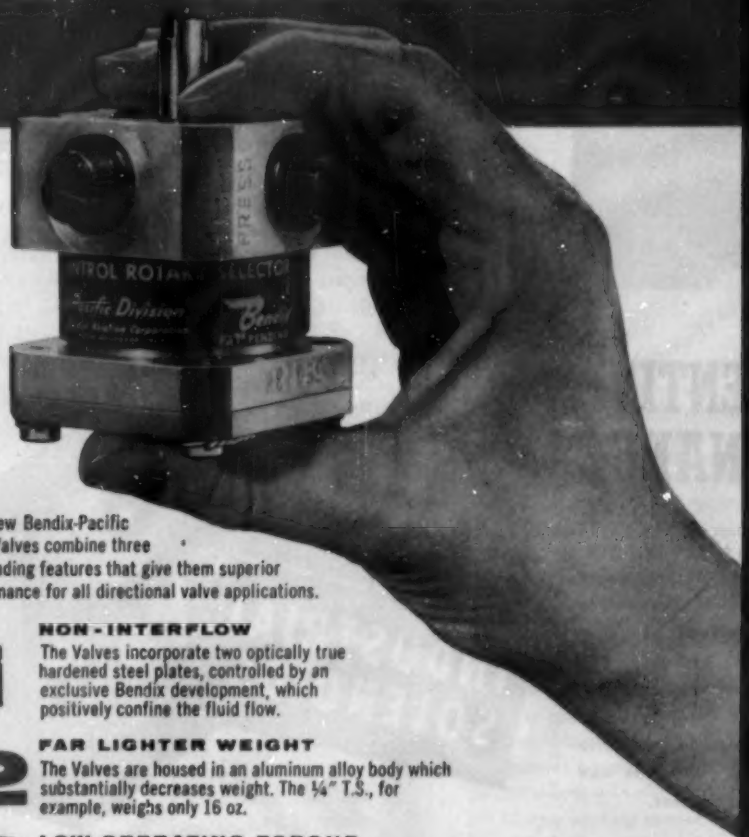
SEND your specifications for hydraulic cylinders to American, specialists in hollow boring and honing. We manufacture from tubing or forgings in carbon or alloy steels up to 15" I.D. Over 40 years experience backed by precision machines and skilled craftsmen will save you time and money. Send your blueprints.

AMERICAN HOLLOW BORING COMPANY
1954 RASPBERRY STREET • ERIE, PA.

Announcing

Bendix-Pacific

NON-INTERFLOW HYDRAULIC ROTARY PLATE VALVES



The new Bendix-Pacific Plate Valves combine three outstanding features that give them superior performance for all directional valve applications.

1 **NON-INTERFLOW**
The Valves incorporate two optically true hardened steel plates, controlled by an exclusive Bendix development, which positively confine the fluid flow.

2 **FAR LIGHTER WEIGHT**
The Valves are housed in an aluminum alloy body which substantially decreases weight. The ¼" T.S., for example, weighs only 16 oz.

3 **LOW OPERATING TORQUE**
Due to the simplicity and minimum number of parts, handle loads are unusually light.

Bendix-Pacific Valves are now available for 1500 and 3000 PSI systems. The Valves are designed in accordance with MIL-V-5529A.

Write or wire for complete information

RADAR

SONAR

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TELEMETERING

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BENDIX PACIFIC

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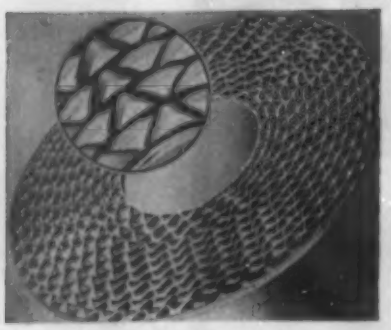
thinking of PM*?

Don't overlook the FRANTZ

Magnetic Separator

FERROFILTER



* PREVENTIVE MAINTENANCE

Here's one of a stack of strongly magnetized grids, the hard-working heart of a FRANTZ FERROFILTER. These grids comb and recomb ferrous particles, rust and scale out of hydraulic oils. This keeps high pressure pumps and valves free to operate at highest efficiency; protects all surfaces subject to wear, reducing costly shutdowns and repairs of hydraulic equipment.

Send for BULLETIN PM-65

with complete information on how they are made and operate; in sizes available, dimensions and capacities.

If you're "from Missouri" try one on our rental plan.

S. G. FRANTZ CO., Inc.

P. O. Box 1138 Trenton 6, N. J.

upward through the desiccant bed. Dry air leaves the unit after passing through a visual saturation indicator. Will provide dew points as low as –67 F.

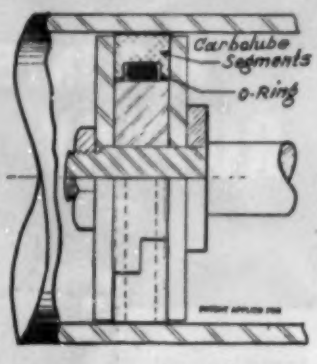
Features: The unit is a small desiccant air and gas dehydrator. Rated at 1 scfm at 100 psig and 70 F. Features a disposable desiccant cartridge and "O" ring seal construction which eliminates the need of tools to change the cartridge.

Hankison Corporation, Pittsburgh 16, Pa.

Circle 179 on Reader Service Card

NEW SEAL DESIGN . . . for dynamic applications

Features: Resilient elastic material in the form of the "O" ring or extruded lengths, function not only as the expander for the segmented ring, it also forms a dependable seal between the under-side of the ring and the piston groove. Any by-pass of pressure between the ring side-wall and the piston side-wall functions as an additional expanding force. Low compression set silicone material operates efficiently under a wide temperature range. Resilient elastic tubular material is used where a mild expanding force is required. Carbolube operates up to 7000 surface feet per minute. Light weight pistons may be used. The



Decco gives you a complete range of small, short-stroke, low-amperage, push or pull Industrial Type Solenoids manufactured with all the high quality of Decco Standard Size Solenoids. Built to J.I.C. specification, Decco Small Solenoids are shock-mounted to reduce self-destruction, have silicon steel laminations for efficiency, hardened beryllium-copper plunger guide, and heavy Formvar insulated magnet wire on high flow point molded nylon bobbins.

SPECIAL SOLENOID PROBLEMS ENGINEERED TO YOUR NEEDS

DETROIT COIL COMPANY

2435 HILTON ROAD • DETROIT 20, (FERNDALE) MICHIGAN

rings may be run dry or lubricated and they will not score cylinder walls. Static friction is low, so there is almost no breakaway or starting friction. Reciprocating rod and rotating shaft packings operate in a similar manner and require no gland nuts. A retaining ring is sufficient which eliminates frequent troublesome adjustments. The resiliency of the "O" ring materials allow the seal rings to follow rotating shaft vibrations.

Ferris & Company,
San Gabriel, Cal.

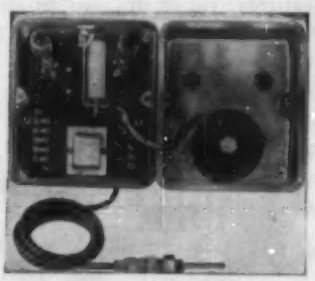
Circle 180 on Reader Service Card

ELECTRONIC TEMPERATURE CONTROLLER

. . . has high sensitivity

Designation: Series 97

Design: High sensitivity, long term stability and reliability are



features in this two-zone controller. It uses a resistance temperature detector element as a sensing device in a bridge circuit in conjunction with a high gain phase sensitive amplifier relay unit.

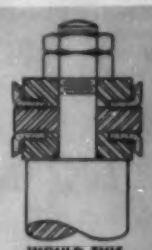
Specifications: A single dial sets the temperature control point and the red and green lights indicate whether the temperature is above or below the set point. The single pole two-way control contact will handle 220 volts at 5 amps. Standard ranges are 0 to 100, 300 or 500 F and C but any range between the limits of minus 200 to plus 500 C can be supplied in conjunction with an appropriate bulb.

Application: The unit is designed for a wide range of industrial applications in all industry where accurate temperature control is required. This includes specific applications in petro-chemical processing, the

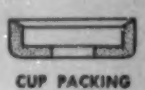
quality control

MARSH IMPREGNATED LEATHER PACKINGS

to your specifications



WOULD THIS SOLVE YOUR ENGINEERING PROBLEM?



CUP PACKING

FLANGE PACKING

U PACKING

VEE PACKING

NON-EXTRUSION WASHER

DIAPHRAGM

Your packing problem—where quality control determines the successful application—has a solution! MARSH with more than half a century of experience plus continuous on-the-job and laboratory research, supplies the mechanical leather packing for your job—cut, formed, treated, engineered to meet YOUR SPECIAL REQUIREMENTS.

MARSH Field Engineering and Consulting Service, quickly available, helps you determine the specific leather packing for greatest efficiency, longer wear, lower cost — for your job.

MARSH PACKINGS, selected, tanned, impregnated to the job specifications, provide superior custom leather sealing with —

- **Low coefficient of friction** both static and running
- **Greater wear resistance** combining toughness with strength
- **Tighter sealing** proper impregnation for varied pressures
- **Temperature stability** through a wide range of temperatures

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If you seal oil, water, air, vacuum, gas, gasoline, naphtha, alcohol, or other fluids, ask MARSH for field engineering service, immediately available to you for the job you are designing, tooling, manufacturing.

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Circle 83 on Reader Service Card

GENERANT
PRESSURE REGULATORS

FOR DEPENDABLE PRESSURE CONTROL

For Air, Water, Oils and Gases up to 400 PSI inlet pressure. A quality product at a quantity price. Gives high flows and accurate regulation with low maintenance costs.

Self Bleeding & Non Bleeding Models

GENERANT
FILTERS

FOR CLEAN WATER-FREE COMPRESSED AIR

Low cost protection for valuable equipment. Dirt and water efficiently removed from air by combination of centrifugal action and micronic filter element. Transparent bowl provides visual reminder to drain.

GENERANT
LUBRICATORS

FOR CORRECTLY LUBRICATED COMPRESSED AIR

Introduces uniform oil mist into air stream. Operates on very low intermittent flows. Factory calibrated oil adjustment permits instant duplication of settings. Transparent plastic bowl.

WRITE FOR BULLETINS

GENERANT
ENGINEERING COMPANY
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NEWARK 3, NEW JERSEY

New Products

Continued

plastic molding and extruding field and explosives manufacturing. The unit is also suitable for use in laboratory work.

Fielden Instrument Division, Robertshaw-Fulton Controls Company, Philadelphia, Pa.

Circle 181 on Reader Service Card

CYLINDERS AND VALVES . . . for air circuits

Sizes: Air cylinders from 1½ to 6 in bore

Directional control valves in ⅛, ¼ and ⅜ in bore

Design: Standard air cylinders are fitted with precision drawn steel barrels, which are hard chrome plated and polished in the bore. This ensures freedom from corrosion troubles due to suspended moisture in the air supply and provides a very

hard and highly finished surface to withstand wear due to the constant traversing of the piston head along the bore. Low friction properties of chromium result in smooth action and greatly reduced seal wear. Piston rods are made from precision ground stainless steel bar, which is subsequently polished to keep bearing friction and seal wear to a minimum. A tough synthetic rubber wiper is fitted in all cases, to remove any gritty impurities which may be deposited on the rod when in the extended position. Cylinders in all bore sizes are available with a built in cushion feature, at either or both ends of the stroke. The valving element is a profiled stainless steel spool, which is highly polished to minimize friction.

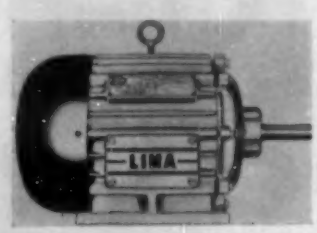
Pneumatics Division, Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England

Circle 182 on Reader Service Card

EXPLOSION PROOF MOTORS . . . up to 20 hp

Designation: Type EX explosion proof, Type E D dust-tight

Features: Incorporates deep, integrally cast fins, provides extra



cooling surface for more rapid heat dissipation without increasing the diameter of the motor frame. The new design has no corners or pockets, no concealed air passages, that can become clogged and retard cooling. A specially designed external fan forces air at high velocity over the outside of the motor. The deep-drawn steel fan housing gives proper direction to this air stream resulting in a motor that literally blows itself clean, continuously. All motor cooling surfaces are exposed and readily accessible.

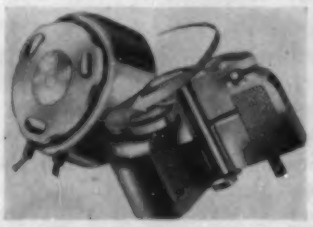
Specifications: Types EX and ED motors are manufactured in ratings of ¾ hp to 20 hp in NEMA frame sizes 224 to 326 inclusive, for operation on 2 or 3 phase, all commercial frequencies and voltages below 600.

The Lima Electric Motor Company, Lima, Ohio

Circle 183 on Reader Service Card

SOLENOID
. . . has rotary motion

Designation: Model No. BD4
Features: Employs the same principal of operation as the other basic models in current production. The magnetic pull moves an armature along the solenoid axis. This linear action is efficiently converted into rotary motion by means of ball



bearings on inclined races. The resulting rotary snap-action power can be efficiently harnessed with a minimum of linkages.

G. H. Leland, Inc.,
Dayton 2, Ohio
Circle 184 on Reader Service Card

NEW TYPE FILTER
. . . prevents air pressure drop

Construction: The outer cylinder of the "dual duty" filter is constructed of ¼ in steel with ¼ in plates welded at each end and has been tested to withstand a hydrostatic pressure of 600 psi. The inner cylinder, comprising the filter element of the assembly, is a steel cylinder 5 in dia by 24 in in length packed with fiberglass.

Operation: The filter serves as a combined auxiliary receiving tank and an efficient filter. A 1 in drain is provided at the bottom of the outer cylinder for the removal of accumulated moisture and oil, and the entire unit is mounted upon an angle iron welded stand.

Applications: When installed in an intermediate position or at the end of an extended line with a check valve, provides an adequate air supply in spots which previously were affected by a pressure drop.

Airlenco, Inc.,
Mansfield, Ohio
Circle 185 on Reader Service Card

Keeps Oils Clean

EVEN WHEN SYSTEMS AREN'T DRAINED FOR A YEAR!

GENERAL AF-500 *Industrial* FILTERS

Keeping hydraulic and lubricating oils free from impurities can be a costly process — one demanding the frequent draining and refilling of entire oil systems. But with the GENERAL AF-500's positive absorption . . . moisture, dirt, rust, tars and lint are *safely trapped* in the finest wool felt, assuring trouble-free, uninterrupted operation of oil systems for as long as a year! Machine parts are protected from abrasive wear and maintenance costs are reduced on both new and old equipment.

No other Filter like it!

TWO-FOLD ELEMENT
The AF-500 actually works two ways — its ALL-WOOL felt element traps *moisture* and dirt particles as fine as *5 microns.*

CLEAN, SAFE LIQUIDS
Clean, completely dependable oils, paints, lacquers and other industrial liquids are assured at 15-20 gpm, depending on viscosity.

LONGER MACHINE LIFE
Both on new and old equipment, GENERALS protect vital machine parts from abrasive wear, greatly prolonging service life.

SIMPLE DISASSEMBLY
Cleanable wool felt cartridge can be quickly removed and washed in any suitable solvent without disturbing inlet or outlet liner. Merely unscrew center bolt, lift off cover and two washers, and remove felt cartridge intact.

WRITE us — without obligation — about your industrial filtering problems.

GENERAL FILTERS, INC.
43800 GRAND RIVER AVENUE • NOVI, MICHIGAN
CANADIAN GENERAL FILTERS, LTD., 2679 DANFORTH AVENUE
TORONTO 13, ONTARIO

Circle 52 on Reader Service Card

Post Scripts of Industry

News about people, manufacturers and sales organizations

Harvey J. Finison
National Pneumatic Co. Inc.

National Pneumatic Co., Inc. and Holtzer-Cabot Divisions, Boston, Mass., announce the appointment of **Harvey J. Finison** as director of engineering. Finison was formerly associated with the Armour Research Foundation, Chicago, as an executive in research and development, and has had broad experience in the application and development engineering fields.

Edward I. Brown
Vickers, Inc.

Edward I. Brown recently joined **Vickers, Inc.** in the capacity of chief aircraft products engineer for the El Segundo, California Division. He will be in charge of engineering for aircraft products designed and developed by this division. Prior to his association at Vickers, Brown was section head and project engineer in charge of accessory turbine drives and turbojet engine controls at Marquardt Aircraft Company for four years. Brown replaces Ben W. Badenoch who has been advanced to the position of aircraft products sales manager. Badenoch will move to the Vickers general office at Detroit, Mich.

B. L. Walter
The Rucker Company

Boyd L. Walter has been named field engineer for **The Rucker Company** in Fresno and the San Joaquin Valley areas, it was announced by Clark E. Rucker, president of the Oakland distributing firm. Walter's appointment marks the first time that the company has maintained a full time representative in Fresno. As a field engineer, Walter will work closely with local industries in the planning, installation and maintenance of equipment. The appointment of **A. J. Dillon** as manager of the Southgate, Cal., office and plant was also announced. Dillon has been associated with the company's southern California sales staff for the past six years. He joined the firm in 1948 as a sales engineer. During this period he was instrumental in the development and installation of new hydraulic testing devices in major aircraft companies in the area.

Eastman Manufacturing Company, Manitowoc, Wisconsin, announces the appointment of **Betts-Eastman,** Limited, of Winnipeg, Manitoba, as exclusive distributor for western Canada. Factory equipment for the application of their couplings has been installed under the supervision of the company.

Richard M. Morgan, who joined **Miller Fluid Power Company** in March of this year, has been placed in charge of production tooling, production engineering and plant layout at that company. Morgan was formerly a design engineer for Harris-Seybold-Potter Company and process and hydraulic engineer on automotive and aviation tooling for the General Motors Corp. **Dave Alexander** has been appointed as Miller's new salesman for the Philadelphia area and will work with Paul Davison who has been representing the company in this territory for the past year. **Wilfred A. Pehl** has been appointed field engineer for the company in the

Cleveland, Ohio territory. Before joining Miller, Pehl spent several years in customer service and two years as a technician in an atomic research laboratory. **John Howard Shankland** has joined the organization as market research analyst. He was employed formerly in the engineering department of the Western Electric Company. **Terry Morris**, former production control supervisor, has been advanced to the order processing department. Succeeding Morris as production control supervisor is **George Permanian.**

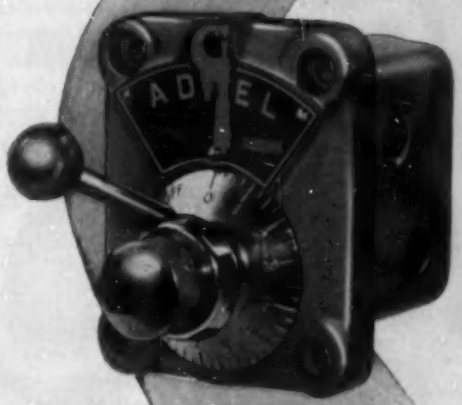
A. J. Dillon
The Rucker Company

The purchase of a new manufacturing plant by the **Warner Division of Detroit Harvester Company** was announced by J. Thomas Smith, president. The new plant, located at 14300 Tireman Avenue, Detroit 28, Michigan, is of modern construction and contains 104,000 sq ft of floor area, more than doubling the former facilities. The plant has an air conditioned office, internal loading wells, an overhead crane way and a railroad siding.

William Traynor was appointed assistant service manager at the Aircraft Products Division of **Air Associates, Inc.** In his new position Traynor is responsible for coordination of liaison activities of field service representatives at the Aircraft Products Division in Teterboro and Air Associates' branches throughout the country. With Air Associates for the past five years, he was formerly employed in the sales department at Teterboro.

THE NEW **ADEL**

FLOW CONTROL VALVE FOR VERSATILITY



Adjustable from completely shut off position to 25 G.P.M. maximum flow. Will maintain constant fluid flow and constant machine feed over a wide range of pressures and feed resistances.
The diagrams show but two of innumerable circuits and systems where this versatile and better valve can be used to advantage.

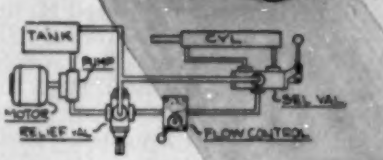


Diagram illustrates typical circuit showing control of cylinder.

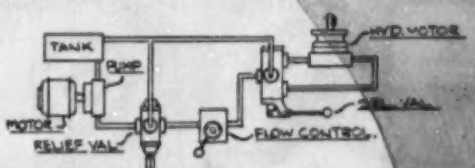


Diagram illustrates typical circuit showing control of hydraulic motor.
8 model variations are available—⅜ in. Pipe Size—1, 2, 4 & 6 G.P.M. Flow Max.
½ in. Pipe Size—10, 15, 20 & 25 G.P.M. Flow Max.

CHARACTERISTICS

1. Valve is compensated type which maintains substantially a constant flow regardless of variation in inlet and outlet pressure.
2. Maximum recommended inlet pressure 1500 P.S.I.
3. Maximum recommended outlet pressure equals inlet pressure minus 100 P.S.I.
4. No drain line required.
5. Wide range of control lever rotation (270°) permits extremely accurate flow settings.

A FEW SELECT TERRITORIES ARE STILL AVAILABLE TO PROGRESSIVE DISTRIBUTORS OF HYDRAULIC EQUIPMENT. INQUIRIES INVITED.

For complete engineering specifications and counsel, Address: ADEL DIVISION—GENERAL METALS CORPORATION, 10777 Van Owen Street, Burbank, California.

ADEL LEADER IN HYDRAULICS

DIVISION OF GENERAL ...PORATION · Burbank, Calif.

Manufacturers of Industrial Hydraulic Control Equipment

DISTRIBUTORS: AIR & HYDRAUUC CO., NEW HAVEN, CONN. • RUSS CHAMBERLIN COMPANY, PORTLAND, OREGON • J. BOYD COATES, PHILADELPHIA, PA. • FRANK T. DONNELLY COMPANY, PITTSBURGH, PA. HASKEL ENGINEERING & SUPPLY CO., SAN FRANCISCO, CALIF. • HASKEL ENGINEERING & SUPPLY CO., GLENDALE, CALIF. • HYDRAUUC BRAKE SUPPLY CO., PHOENIX, ARIZ. • LINCOLN SUPPLY CO., PROVIDENCE, R. I. • SCOTT EQUIPMENT AND ENGINEERING COMPANY, DAYTON, OHIO • H. F. SODERLING CO., SEATTLE, WASH. • ROBERT TAYLOR & SONS, SALT LAKE CITY, UTAH • WYATT SALES COMPANY, CLEVELAND, OHIO • CORBY SUPPLY COMPANY, ST. LOUIS, MO. • INDUSTRIAL AIR & HYDRAUUC EQUIPMENT CO., DETROIT, MICH.

O-M FIELD ENGINEERS

help you get the most from air or hydraulic cylinder applications...

The technical training, experience, and resourcefulness of O-M Field Engineers is available to any manufacturer who has an Air or Hydraulic application problem.

In many cases, the recommendations of these specialists result in improved design, more efficient machine performance and economies in production.

The O-M Field Engineer in your area would welcome an opportunity to discuss your Air and Hydraulic applications with you on an engineering level, in your plant. Simply contact any of the O-M Representatives listed in this advertisement or mail the coupon below. No obligation, of course.

SALES REPRESENTATIVES

J. NEILL ARMSTRONG — Westwood, New Jersey
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GILMORE SALES COMPANY — Detroit, Michigan
NEIL GROOM — Toronto, Ont., Canada
HACKETT BROS., INC. — No. Manchester, Indiana
H. C. HALBERT — Atlanta, Georgia
H. U. HOGNESS INC. — Minneapolis, Minnesota
IND. SALES & ENGR. CO. — Houston, Texas
IND. SALES & ENGR. CO. — Tulsa, Oklahoma
KNOX, INC. — East Walpole, Mass.
H. G. MACRAE — Rochester, New York
JAMES T. McSHANE — Phoenix, Arizona
THE MERCER COMPANY — Milwaukee, Wisconsin
WALTER NOBBIS ENGR. CO. — Chicago, Illinois
PNEUMATIC ENGR. CO. — West Hartford, Conn.
P. W. RICE — Cleveland, Ohio
THE RODEN COMPANY — Cranford, New Jersey
THE RUCKER COMPANY — Oakland, California
THE RUCKER COMPANY — Seattle, Washington
THE RUCKER COMPANY — South Gate, California
T. H. SCAPPS — St. Louis, Missouri
SMITES SALES ENGR. — New Orleans, Louisiana
ROBT. TAYLOR & SON — Salt Lake City, Utah

O-M AIR, HYDRAULIC CYLINDERS Fit where others won't!

O-M CYLINDERS available in full range of sizes (1½ to 8" bores) with standard, 2 to 1 or oversize rods. Completely interchangeable parts. Write for FREE catalog.

MAIL COUPON NOW!

ORTMAN-MILLER MACHINE CO.
1204 150th Street - Hammond, Ind.

☐ Please have representative call
☐ Please send latest catalog

Name_____
Company_____
Address_____
City_____ Zone____ State_____

Post Scripts of Industry

The Standard Pressed Steel Co. has moved **Joseph P. Villo** and **Frederick D. Fernsler,** two of the firm's management team, into top division sales posts. Villo, formerly superintendent of form and finish, was appointed division manager of aircraft and allied products. He has charge of sales, sales service and shipping in the division. Fernsler, who was manager of production control, was made manager of the Unbrako-Flexloc Division, with responsibility for sales, sales service and shipping.

Frederick D. Fernsler
The Standard Pressed Steel Co.

Joseph P. Villo
The Standard Pressed Steel Co.

Hoke, Inc., Englewood, New Jersey, announces the appointment of the following new distributors; **Joseph H. Bertram & Co., Inc.,** 223 Harvard St., Brookline 46, Mass.; **Crawford Fitting Co.,** 884 East 140th St., Cleveland 10, Ohio; **R. S. Crum Co.,** 4 New Providence Road, Mountainside, New Jersey; **Fogleman**

★ONLY THREE PARTS
★MEETS J.I.C. STANDARDS
★GREATER FILTERING AREA
★SPECIAL TRAP-WEAVE MESH

The New

CAPITAL HYDRAULIC OIL FILTER

WITH MONEL METAL INSERT

Reservoir Type for Hydraulic and Oil Re-Circulating Machinery

EASY TO INSTALL • EASY TO CLEAN • LONG LIFE • LOW COST

SIZES AND SCREENS TO FIT YOUR NEEDS

CAPITAL ENGINEERING & MFG. CORP.
5837 South Ashland Avenue Chicago 36, Illinois

Company, 3737 Poplar Ave., Pittsburgh 34, Pa.; **Shelby Jones Company,** P.O. Box 514, Havertown, Pa.; **Greg Moody Co.,** 40 Ash Street, Park Forest, Illinois; **Ray Moody Co.,** 1813 Edinburgh St., Baton Rouge, La.; **James C. White Co.,** 7 Clarendon Ave., Greenville, S.C.; **Carl A. Pearson Co.,** 104 Colonial Village Road, Rochester 10, New York; **W. H. Curtin & Co.,** 4220 Jefferson Ave., Houston 1, Texas.

R. B. Werey, president, **Conoflow Corporation,** announces the formation of a new department to handle specialized engineering problems in the sales and application of company equipment. **E. K. Graham, Jr.,** former chief engineer, has been named manager of technical services and will head the new department. Graham has been with the company for more than ten years and is well known in the field of automatic control.

Thomas H. Brumagin was elected to the board of directors at the annual meeting, of the **Ajax Flexible Coupling Co. Inc.,** Brumagin is chief engineer and has been associated with the company since 1946.

Building construction has been complete and pilot operations are under way in a new plant by **Goshen Rubber Co.,** Inc., Goshen, Indiana, for fabricating precision molded silicone parts. Located adjacent to the main plant, the new structure when in full operation will house the latest facilities and departments, including presses, mills, extruders, curing ovens and trimming equipment.

William L. Milheim, William B. Sinclair, W. D. Matthews and **J. W. Morton,** all of whom have been connected with the sales department of the **Chemical Division** of **Celanese Corp. of America** for varying periods have been promoted to district sales managers. Mr. Milheim is

UNDEFEATED!
AND
STILL
CHAMPION
CAN YOU SUPPLY A CHALLENGER?
. . . That difficult fluid, gas, or air transmission problem in your plant—We'll send you a Snap-tite Hi-Flow quick connect disconnect coupling with or without automatic shut-off in any size 1/8" to 3"—Test it in your plant, under actual working conditions—You be the judge—If it doesn't solve your problem or do a better job than the coupling you are now using, ship it back collect—Write today on your letterhead, briefly outlining your problem—We'll ship immediately.
Snap-tite
INC.
201 S. Rockwood, Union City, Penna.

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Backed by more than a century's experience

BRITISH

Hydraulic Plant

& Equipment

LEAD THE WORLD

Look for our announcement in the October issue of Applied Hydraulics.

The* Hydraulic Association *of Great Britain

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94/98 Petty France, London, S.W.1. England
Telephone: Abbey 1845.

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Cables: Crusade, Sowest, London.

Post Scripts of Industry

in charge of the southeastern district with offices in Charlotte, North Carolina. Mr. Sinclair is district manager for New England with offices in Boston, Mass. and Mr. Morton and Mr. Matthews are metropolitan and mid-Atlantic district managers, respectively, with offices in New York City.

Edward O. Boshell, president and board chairman of **Westinghouse Air Brake Co.**, announced that **James A. Carlson** has been appointed assistant vice president for sales coordination. He joined the company in 1951 to become assistant to the president.

Aeroquip Corporation, recently announced the appointment of **Robert Conant** as chief inspector. In 1951 Conant was appointed general manager of Metalco, Inc., wholly owned subsidiary of Aeroquip in Cheboygan, Mich. When operations in this plant were halted in 1953, he returned to the Jackson plant as plant engineer. In his new position, he will be responsible for all quality control functions at the Jackson plant.

Crockett A. Harrison has joined the administrative staff of Raymond P. Lansing, vice president and group executive of **Bendix Aviation Corp.** Harrison was formerly vice president in charge of sales of the Fairchild Camera and Instrument Corp.

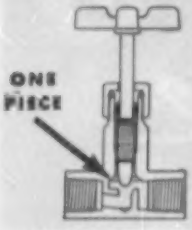
The appointment of **Henry W. Doctor** as a district sales manager for the Tubular Products Division of **The Babcock & Wilcox Company** was announced by James S. Anderson, general sales manager of the division. Doctor will take charge of the

New
MARSH
Needle Valves

MAXIMUM WORKING PRESSURE 10,000 PSI

. . . for finer regulation of water, oil or gas

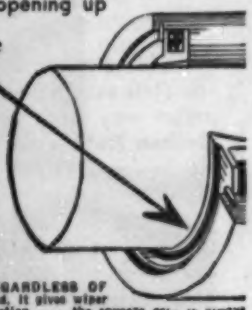
First needle valve to combine all the characteristics called for in modern industry. Embodies sturdiest basic construction—machined from solid bar stock—suitable for pressures to 10,000 psi and equally efficient in lower range. Note stem guide fused to body by new "Conoweld" process, eliminating faults of conventional two-piece valves. Stem 416 stainless steel. Stem threads fine pitch for strength and micrometer regulation. Body electro-zinc plated. Sizes ⅛" to 1", globe and angle patterns.



Ask for new Needle Valve Catalog

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*
Dept. 19, Skokie, Ill.

Cover Band
Holds
Spring automatically in place preventing ring from opening up
Here



Stops Build Up of Ice,
Mud or other Foreign Bodies between Rod and Ring . . .

The wiper edge of the FALL Wiper Ring is TIGHT against the piston rod at all times REGARDLESS OF WEAR. Spring-Loaded, it gives wiper edge a squeeze grip action . . . the squeeze grip is always the same because of the uniform tension of the spring under the endless cover band.

Squeeze Grip Action Does It—*patented*

Ice, grit and other foreign bodies do NOT Build Up under ring. Rod does not stick or become immobile in ANY temperature . . . the FALL ring has complete contact on rod ALL WAYS, always.
Finish on FALL Wiper rings. Available from ½" to 12" dia. Military part numbers from AN6231A1 to AN6231A71. Write, wire or phone us your wiper needs.

Used During World War 2 and ever since by the Military.
Fall Wiper Rings Meet MIL-R-5510 are AN approved.
Covered by patents issued and patents pending.

Ace Products Co., Toledo 1, Ohio. Phone ADams 0313

Ask About FALL Wiper Rings with Closed Joint
Especially designed for those applications where absolute freedom from dirt passing through joint of ring is required.

You can depend on ACE PRODUCTS—Established 1915!

Fall Wiper Ring SPRING LOADED

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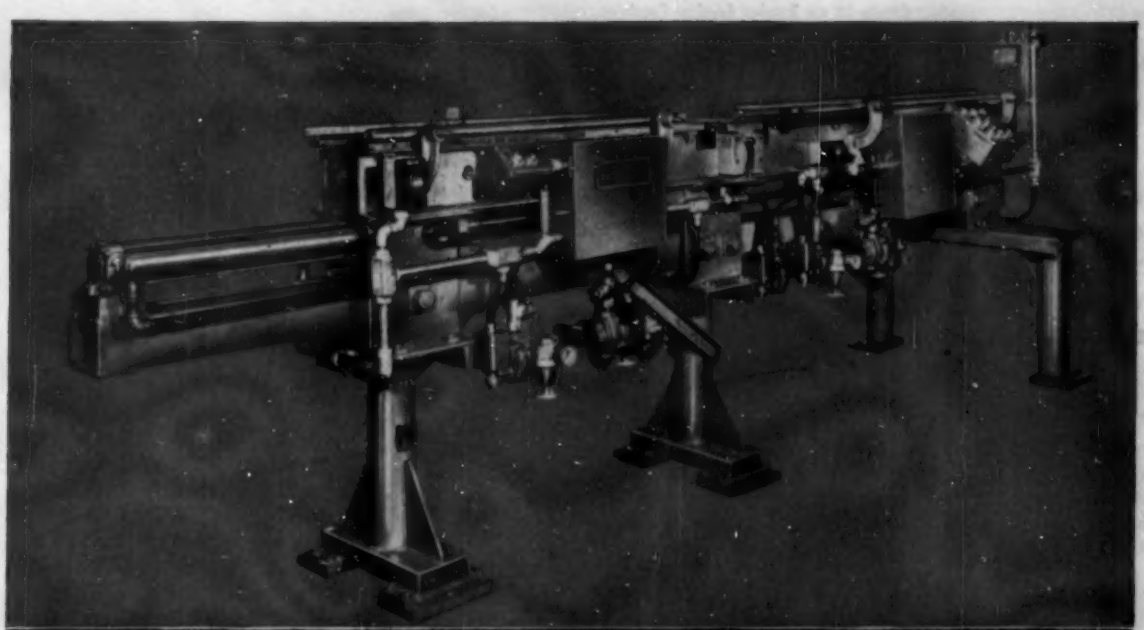

au·to·ma'tion: *the linear transfer of parts between automatic machines*

. . . sooner or later, you'll come to grips with automation, a production technique that relies heavily on electrically controlled air cylinders. Hannifin air cylinders and Hannifin "P-M" (electrically controlled, air-operated) valves have proved ideal for this purpose, are now in use on some of the largest automation projects.

. . . our application engineers will be glad to work with your automation engineers.

HANNIFIN

For help with air or hydraulic circuits call in your Hannifin Field Engineer. *Meanwhile, write for catalogs!*

Hannifin Corporation, 1155 S. Kilbourn Ave., Chicago 24, Illinois

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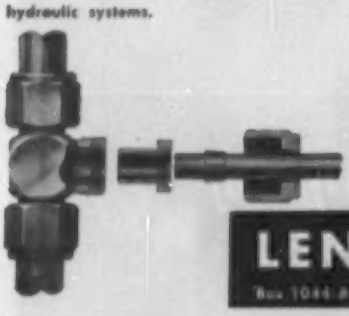
Circle 78 on Reader Service Card

LENZ "O-RING" TUBE COUPLINGS

ELIMINATES
FLARING,
THREADING,
WELDING,
SOLDERING

A HACKSAW AND FILE IS ALL YOU NEED

Excessive wrench torque is unnecessary for seal does not depend upon tightness of the nut. Nut fits loosely on the tube for ease of assembly. The higher the pressure the tighter the grip. LENZ FITTINGS are ideal for quick, simple, easy to assemble, leak-proof connection — for steel or copper tubing — on air and hydraulic systems.



DO YOU KNOW ABOUT
LENZ REDUCER COUPLINGS?

Reducer couplings are adapters for standard bodies, making possible line reductions on any leg by use of standard adapters and adapter nuts.

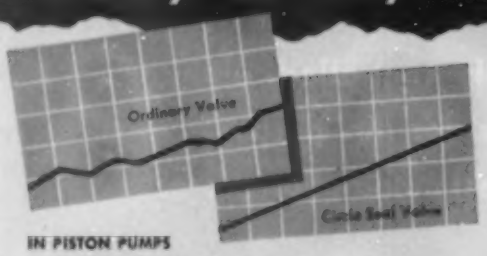
LENZ COMPANY

Box 1044-B • Dayton 1, Ohio • ME 2552—MI 7985

new district sales office being established in Cincinnati, Ohio, and will supervise the sales of the company's seamless and welded stainless, alloy and carbon steel tubular products in the area. The territory to be served by the new office includes southern Ohio, southern Indiana and the states of Kentucky, Tennessee, Alabama, Georgia, South Carolina, North Carolina and Florida.

Edgar S. Peierls, president, has announced that **Resistoflex Corporation,** Belleville, New Jersey, has opened a new office and assembly station in California. The new quarters will be at 4414 West Jefferson St., Los Angeles 16, and will include equipment for supplying test and small production quantities of these materials for immediate needs. Representative stocks of the company's hose and fittings will be maintained. **Robert E. Bowen,** for several years the company's west coast representative, will be in charge of the new office.

Check Valve Leakage Destroys Efficiency...



IN PISTON PUMPS
IN PLUNGER PUMPS

In hydraulic pumps, in chemical proportioning pumps—where constant volume must be maintained and leakage cannot be tolerated, Circle Seal Check Valves with floating "O" Ring construction provide the perfect answer because...

Circle Seal Check Valves NEVER Leak!

Write for catalog information today

CIRCLE SEAL *precision valves*
JAMES•POND•CLARK
2181 E. Foothill Blvd., Pasadena 8, Calif.

Prominent User Acclaims

"M-B" Automatic Air Line FILTER, REGULATOR and LUBRICATOR Assembly

The value of "M-B" Automatic Air Line Filters, Regulators and Lubricators is widely known for their effectiveness as a protection to Air Valves, Cylinders, Pneumatic Tools, etc.

"Your 'Sentinel of the Air Line' has been giving us very good service. We have had no complaints at all and I trust that we will be ordering more of them in the near future."

signed: A. E. Cranston, Sr.
PRESIDENT
Cranston Steel Strapping Co.
Oak Grove, Oregon

Write for Literature

M•B PRODUCTS
Division of Tool Sales Co.
46 Victor Ave., Detroit 3

Circle 69 on Reader Service Card

Circle 86 on Reader Service Card

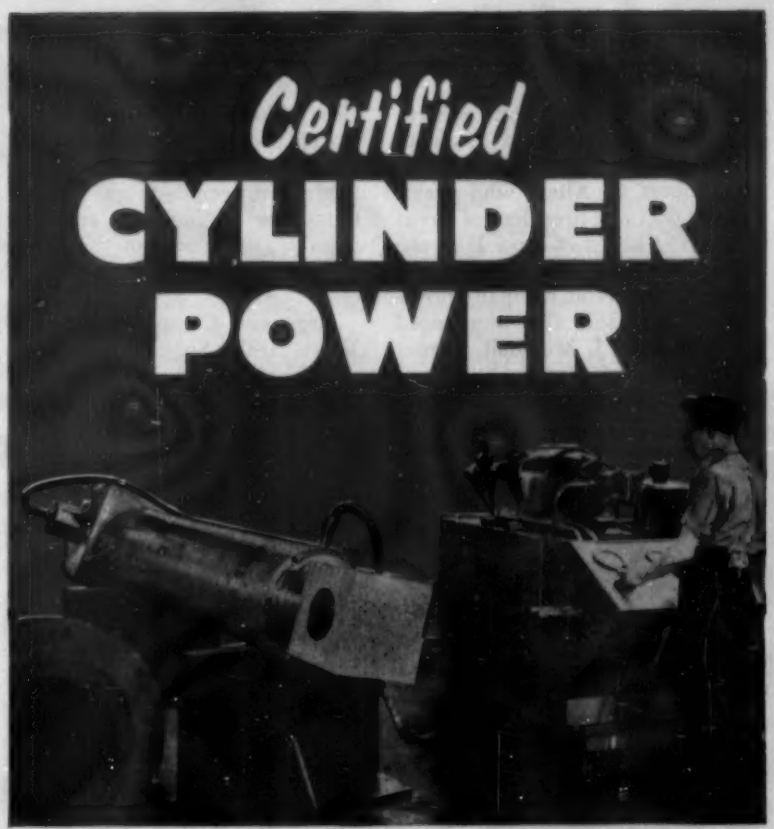
Post Scripts of Industry

James A. Plummer & Company has been appointed exclusive industrial sales representative for the middle Atlantic states by the **Cuno Engineering Corp.** Plummer has been with the company for several years in various executive capacities, including general sales manager. **Arthur T. Lawley** will be associated with Mr. Plummer.

Two **Worthington Corporation** executives have been promoted as announced by Frank J. Whelan, sales vice president. **William H. Wheeler,** former vertical air compressor division manager, Holyoke Works, has been appointed sales manager of Holyoke Works air products. After filling various assignments, he was named manager of the vertical air compressor division in 1948, in which capacity he served until his present appointment. **A. C. Nolder,** formerly assistant manager of Holyoke Works vertical air compressor division, assumes Wheeler's former post of manager of the air cooled compressor division. Nolder joined the company in 1935 where he was engaged in Diesel engine and compressor test and research. In 1947 he was named assistant manager of the vertical air compressor division.

Whitley C. Collins, has been elected president and chief executive officer of **Northrop Aircraft, Inc.** succeeding General Oliver P. Echols who recently passed away. Collins has served as a director of the company since 1952. He also is president of the Radioplane Company, a wholly-owned subsidiary of Northrop.

Uniform Tubes, Inc., Collegeville, Pa., announces the appointment of **David C. Clem,** 1420 Walnut Street, Philadelphia, Pa., as representative for eastern Pennsylvania, southern New Jersey, Maryland and Delaware.



Testing Anker-Holth Hydraulic Cylinder to be used on a metal stretch forming press. Cylinder on test is 16" bore, 69½" stroke, for 3000 psi operating pressure. Tested at 4500 psi.

Thorough testing of Anker-Holth Cylinders assures you dependable power

● Every Anker-Holth Cylinder . . . large and small . . . is tested at 150% of working pressure with the latest completely-filtered testing equipment. Anker-Holth testing facilities include portable units such as the one shown . . . also stationary equipment for pressures up to 10,000 psi.

This is one of the many safeguards in manufacturing to assure you top performance and dependability in Anker-Holth Cylinders. There's a type and size of cylinder to match *your* need. Anker-Holth engineering know-how is available to help solve your power motion problems. Call or write ANKER-HOLTH DIVISION of the Wellman Engineering Co., Dept. C-13, 2723 Conner St., Port Huron, Michigan.

FREE: *Bulletin on complete line of ANKER-HOLTH products.*

Anker-Holth
ENGINEERED CYLINDER POWER
WELLMAN

Division of THE WELLMAN ENGINEERING COMPANY

Post Scripts of Industry

New president and general manager of the **Pesco Products Division of Borg-Warner Corp.** is **Robert G. Allen,** who previously was vice president of Great Lakes Carbon Corp. His appointment was announced by Roy C. Ingersoll, company president. Ingersoll also announced that **Robert J. Minshall,** former president of Pesco, has been named chairman of the supervisory board and director of research and development for the division. Minshall's career in industry has been distinguished by numerous engineering achievements, particularly in the aviation field.

Argo and Company, 7 South West 18th St., Birmingham, Alabama, has been appointed distributor for Hoze-Lok fittings and hose assemblies, according to D. A. Cameron, sales manager of **The Parker Appliance Company** of Cleveland. M. M. Argo, Jr., vice president of the distributing firm announced that warehouse stocks of Hoze-Lok fittings would be maintained. Argo and Company will have access to the technical assistance of R. D. Beatty, Jr., sales engineer in Birmingham.

Appointment of **Lawrence C. Connolly** as manager of the Boston sales office of **Fielden Instrument Division,** Robertshaw-Fulton Controls Company, has been announced. Connolly joined the company in 1950 as sales engineer and for several years has covered the New England area.

At its annual meeting, the Skinner Chuck Company and Skinner Valve Division announced the election of president **Arthur E. Thornton** as chairman of the board of Directors. **Paul K. Rogers, Jr.,** vice president succeeds Thornton as president of the company. Thornton has been with the company for thirty-nine years. He was made a director in 1931, a vice president in 1936 and president in 1938. Rogers was also re-elected treasurer and to the board, on which he has served since 1938.

Hugo Lorant, vice president and member of the board of **Hydropress, Inc.,** New York, has been elected senior vice president. **Paul Mayer** becomes assistant vice president of the company.

J. F. Roberts, vice president and director of engineering of **Allis-Chalmers** general machinery division, has announced the appointment of **R. C. Allen** as director of mechanical engineering, and **L. J. Linde** as director of electrical engineering for the division. Allen has been consulting engineer in the office of the director of engineering since 1951. Linde was appointed in

According to our customers, they continue buying Ledeen Cylinders because, "You people knock yourselves out to give us good service, and your cylinders perform better and last longer."

At Ledeen we perform no miracles, but we do give you quick delivery, good service, and, above all, a good sturdy, reliable cylinder.

Ledeen Cylinders are good cylinders.

Write for Bulletin 500.

VALVES • CYLINDERS
VALVE ACTUATORS
AIR-HYDRAULIC
PUMPS & BOOSTERS

Ledeen Mfg. Co.
1610 So. San Pedro St.
Los Angeles 15, Cal.

1951 as assistant general manager and chief engineer of the Boston works.

John D. MacGuffin
The Briggs Filtration Co.

H. K. Woodward
The Briggs Filtration Co.

The Briggs Filtration Company has announced the following changes. **H. K. Woodward,** formerly regional manager of the north eastern and north central regions, has been promoted to the position of general industrial sales manager. **John D. MacGuffin** has been named regional manager of the north central, with headquarters in Chicago and **C. J. DeVries,** regional manager of the south eastern region. R. A. Rowland will continue to be regional manager of the south central region.

Vice president John C. Koch of the **Conoflow Corp.,** Philadelphia, announces the appointment of **Cyberno Products Company** as exclusive representatives for Cuno Controls in the New York area. Cyberno Products with offices at 30 Church Street, New York will cover metropolitan New York, northern New Jersey and the state of Connecticut. The Conoflow account will be handled by **Charles P. Boyd** and **William E. Hagan** both of whom were with Conoflow Corp. at the home office in Philadelphia, before becoming associated with Cyberno Products.

H. J. Schlarb has been promoted to the newly created position of special representative in the sales department of **Chiksan Company** and **Chiksan Export Company.** In his new capacity, Schlarb will maintain close contact with key personnel of customers and prospects, and with visiting personnel of foreign operations. In addition, he will handle special assignments and projects.

R. R. Jenner, formerly chief radio and electronics engineer for Beech Aircraft Co., has been appointed to the newly created post of director of airborne products for **Micro Switch** of Freeport, a division of Minneapolis-Honeywell Regulator Company. He will be directly responsible for the design and production of all products destined for use in the aircraft industry.

ALWAYS...MAINTAIN CONSTANT, UNIFORM HYDRAULIC PRESSURE
NO NOISE . . . NO MAINTENANCE

America's most dependable valves . . . select from 5 springs for desired pressure from 0# to 500# . . . and INSTALL, NO FURTHER ATTENTION NEEDED . . . EVER.

Standard and Flange models
Pipe sizes: 1/4" to 2"; brass or cast iron bodies.

PROVED MOST SUCCESSFUL AND ECONOMICAL for machine tool hydraulic mechanisms, oil-burning equipment, rams, presses and Diesel engines.

WRITE—on your letterhead—for your personal copy of
FULFLO MECHANICAL DATA BOOK.
Specify if for Valves, for Pumps or for both.

FULFLO
THE FULFLO SPECIALTIES CO. Inc.
PUMP AND VALVE MANUFACTURERS
BLANCHESTER, OHIO

USEFUL LITERATURE

You'll find many valuable production and design ideas in publications described here . . . copies will be sent you free without obligation

Continued from page 12

SYNTHETIC RUBBER "O" RINGS . . . Bulletin OB-1152, prepared by United States Gasket Co. completely describes the company's line of "O" rings and back-up rings. Illustrations show the operation of "O" rings with and without back-up rings at increasing pressures. Information is given on how to order the "O" rings and back-up rings. All standard sizes are listed. Included also are the nominal and actual dimensions.

Circle 206 on Reader Service Card

QUICK SEAL HOSE COUPLING . . . for water and oil provides permanent freedom from leakage. The 16 page booklet, "Titeflex Quick-Seal Coupling" has been released by Titeflex, Inc. The construction of the coupling is described together with valve modifications which permit the disconnecting of lines without shutting down pumps while preventing the escape of fluids when lines are opened. Right-angle connections and dirt exclusion covers are also described. Pressure, material and size tables are included.

Circle 207 on Reader Service Card

HEAVY DUTY LIMIT SWITCH . . . A new 4 page brochure, LS54A, has been published by R. B. Denison Mfg. Co, describing in detail, the electrical, mechanical and maintenance characteristic of the heavy duty limit switch which is designed expressly for machine tools. The switch has a trigger type mechanism and has the bounce characteristics of a light duty switch, combined with the vibration resistance of a heavy duty switch. The booklet called "The Inside Story" shows large cut-a-way photographs of the switch. The bulletin contains complete catalog information, dimensional drawings, ampere ratings and other specifications.

Circle 208 on Reader Service Card

V-BELTS . . . A new 8 page catalog 2170, has been published by the B. F. Goodrich Industrial Products Division, Akron, Ohio. Cut-a-way drawings illustrate construction. New horsepower rating tables permit the design or redesign of V-belt drives. More grip with less stretch under shock loads are features of the belts. Other valuable information is contained under the heading "How to figure a V-belt drive". A table is also included listing the belt numbers, sizes and pitch lengths for each number.

Circle 209 on Reader Service Card

POLY-V-DRIVE . . . is the transmission of power with a single, endless rubber belt with a series of parallel V ribs molded lengthwise around the inside circumference. Sheave grooves are designed to mate precisely with the belt ribs, and the load is distributed equally over the entire driving surface. One of the important features of the new drive explained in a folder prepared by Manhattan Rubber Division of Raybestos-Manhattan, Inc., is that belt matching problems are eliminated. Many other features are explained.

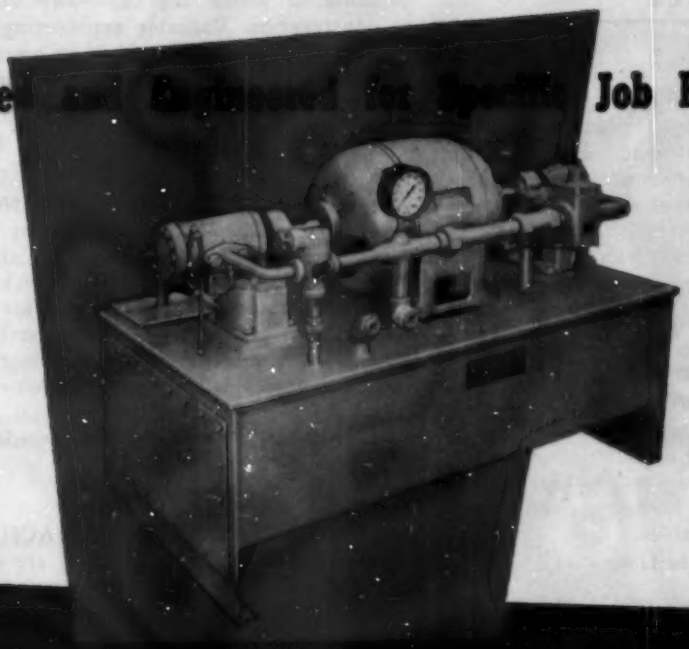
Circle 210 on Reader Service Card

DIRECTIONAL CONTROL VALVES . . . of the spool type, are described in bulletin 203, released by Rotex Punch Company, Inc. The valves are used to direct the flow of an air or low pressure fluid circuit. The force required to position this spool is so small that the operating line pressure effect upon its ease of movement, is slight. The 3-way and 4-way designs are illustrated with cross-section views. Other valves such as hand operated, foot pedal, knob operated, cam stem operated, and others, are illustrated and features outlined. Installation dimensions are also included.

Circle 211 on Reader Service Card

PULSAFEEDER . . . for controlled volume pumping is described in a 24 page two color bulletin No. 440 released by Lapp Process Equipment Div., Lapp Insulator Company, Inc. The maintenance-free feature of no stuffing box is stressed and it is also pointed out that the machine although basically a pump, also functions as a chemical feeder, a meter, an instrument, a filling machine, a proportioner and a sampler. The machine will handle many hard-to-pump fluids, both corrosive and non-corrosive. Both

Designe[illegible] Job Requirements



HYDRAULIC POWER

- BUILT IN ACCORDANCE WITH J.I.C. STANDARDS
- CAPACITY GEARED TO PERFORMANCE REQUIREMENTS
- SPECIAL DESIGNS AVAILABLE ON REQUEST
- TESTED AND PROVEN IN A WIDE VARIETY OF OPERATIONS

The CARDWELL MACHINE COMPANY

Quality — A CARDWELL TRADITION SINCE 1829

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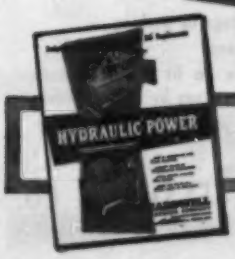


Write for your free copy of this catalog today!

USEFUL LITERATURE

manual and automatically controlled types are described. The auto-pneumatic machine points out its adaptability to automatic volume adjustment from commercial pneumatic instruments. Cut-a-way views and cross sectional views shows the construction. All pertinent dimensions for each of the nine models is given. A load rating chart for various rpm's is also included.

Circle 212 on Reader Service Card

THREAD PROTECTORS . . . tough as leather, flexible as rubber are described in a folder issued by Protective Closures Co. Inc. Characteristics of the material used in manufacture are explained together with size range. Can be used also for masking, when spraying paint. Useful on tubing, fittings and valves.

Circle 213 on Reader Service Card

HEAVY DUTY ROTARY PUMPS . . . of the herringbone gear type and sliding vane type are presented in a 16 page, two color bulletin W-483-B2A, available from Worthington Corp. Very complete information is given in regard to dimensions, speeds, capacities, pressures and power requirements. Many illustrations are included some of which are cut-a-way views, showing construction. Valuable engineering data such as viscosity conversion table is given. This table gives a comparison of various viscosity ratings.

Circle 214 on Reader Service Card

QUICK-LOCK HOSE COUPLING . . . A newly revised bulletin has been issued by the Le-Hi Division of Hose Accessories Co. Catalog No. 6500 consists of 8 pages in color which describe and illustrate in detail the couplings for various applications. Many features are described including the quick engagement and disengagement, prevention of accidental disengagement, and interchangeability.

Circle 215 on Reader Service Card

UNIVERSAL TESTING MACHINES . . . of 20,000 and 60,000 lb capacity are described in a 4-page bulletin No. 4213, issued by Baldwin-Lima-Hamilton Corporation. Complete specifications of the two models produced give all necessary data. Other ranges than those indicated above are available on special order. Principles of their hydraulic straining system and the null method load indicator are given along with descriptions of accessories.

Circle 216 on Reader Service Card

how 10 characteristics of

GAST rotary AIR MOTORS

Model 1AM Up to ⅛ HP — only 2½" dia., weighs 1½ lbs.
Model 2AM Up to ½ HP — weighs approx. 5⅛ lbs.
Model 4AM Up to 1 HP — only 5¼" high (less muffler).
Model 8AM Up to 4 HP — only 6½" high (less muffler).

WRITE GAST for Air Motor Bulletins. Request "Ideas" Booklet.

solve tough original equipment problems

Just one of these ten inherent advantages of Gast rotary Compressed Air Motors may solve knotty problems on your original equipment applications.

1—Low first cost. 2—Explosion-proof safety. 3—Variable speed. 4—Can't burn out from overloads or stalling. 5—Four vanes — instant starting. 6—Amazing compactness for HP. 7—Light weight —to ⅛ of electric motor. 8—Smooth rotary-vane ball-bearing performance. 9—Reversible models. 10—Dependability for long service.

Now standard equipment on many products. Four sizes, many design variations. Vertical or horizontal drives; base or flange mountings.

INVESTIGATE NOW!

Original Equipment Manufacturers for Over 25 Years

GAST AIR MOTORS · COMPRESSORS · VACUUM PUMPS
(TO 4 H.P.) (TO 30 LBS.) (TO 28 INCHES)
GAST MANUFACTURING CORP., 131 Hinkley St., Benton Harbor, Mich.

PROTECT YOUR HYDRAULIC SEALS with the IMPROVED Seal-Guard®

Here is a BETTER WAY to insure long life for cylinder rod packings, bearings, machine spindles, guide pins.

Seal-Guard's flexible bronze, knife-edge wiping rings mould themselves to the shaft contour . . . peel off dirt and grime . . . lift it entirely away from the shaft—no packing or crowding under.

- No chance of fouled bearings or packing.
- Can't damage shaft surfaces.
- Seal-Guards are available to fit rod diameters from ½ to 10 inches. Other sizes by special order.

Write for descriptive literature.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Rd. Van Dyke, Mich.

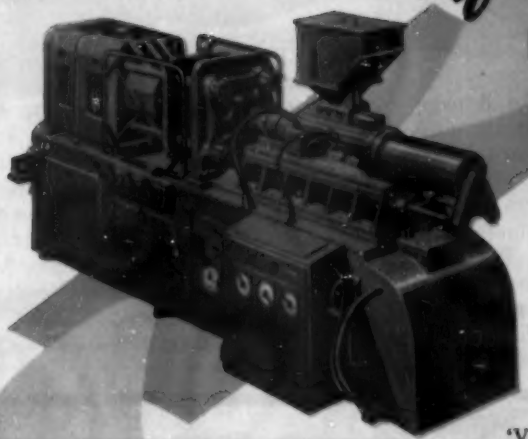
SERVING MODERN INDUSTRY

'VSG'

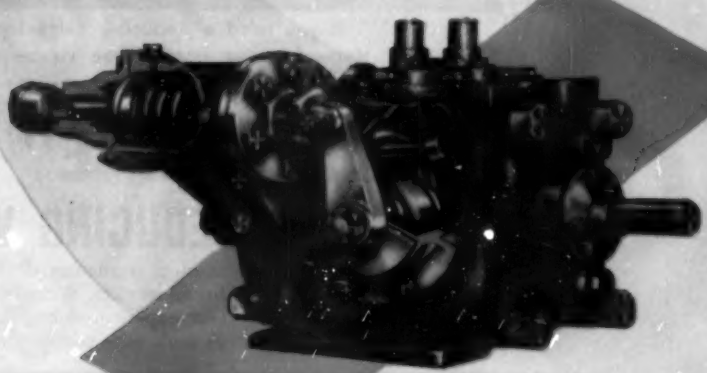
Reg'd Trade Mark

Infinitely VARIABLE DELIVERY PUMPS

The WINDSOR
SH 8/10
Plastic Injection
Molding Machine



'VSG' Auto Pumps are ideal for Injection Molding Machines, the Windsor 10 oz. Machine being a typical example. Standard 'VSG' Pumps and Variable Speed Transmission Gears are available for early delivery. Pump capacities 0-400 gal. per min.: pressure ranges 1,000, 2,000 and 3,000 p.s.i. *Further details will be sent on request.*



'VSG' Variable Delivery Axial Piston Type Pump with Automatic Pressure Control

VICKERS-ARMSTRONGS LTD

VICKERS HOUSE · BROADWAY · LONDON · ENGLAND *Cables* VICASTRONG LONDON

P13c

USEFUL LITERATURE

Continued

TOGGLE SWITCH CATALOG . . . No. 73a has just been published by Micro Switch, a division of Minneapolis-Honeywell Regulator Company. The catalog covers 19 precision snap-action toggle assemblies and over 90 "AN" and "JAN" approved designs, including assemblies that will control from 1 to 24 separate electrical circuits. The catalog has complete dimensions, operating characteristics, electrical ratings and contact arrangements on each switch, as well as an illustration of one representative switch from each group. The switches are designed for aircraft, mobile, marine, railway and other low voltage directional applications.

Circle 217 on Reader Service Card

CONTROLLING DEVICES . . . An 8 page illustrated, two color folder on measuring, indicating, recording devices for use in many different industries, has been published by Schaevitz Engineering. Included are descriptions and illustrations of linear and angular accelerometers for evaluating the performance of vehicles. Technical data accompanies product descriptions and line drawings. A few of the accelerometer types covered are, linear, angular, single variable inductance, also pressure transducers, and recorder systems.

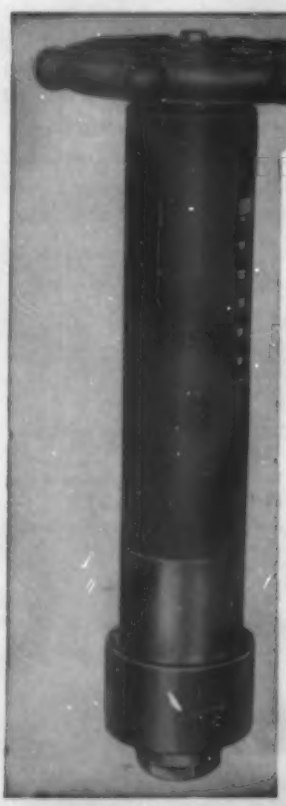
Circle 218 on Reader Service Card

TEST PLUGS . . . and filling connectors seal all types of openings, including standard, flanged, drawn, square, irregular, shallow, deep, threaded or plain openings. Catalog 354, prepared by Mechanical Products Corp. explains the operation of how the sealing is accomplished. Briefly, the self-sealing plugs and connectors utilize test pressure in sealing an opening. A compression spring holds the plug or connector seal against the opening until test pressure is applied. As air or hydraulic pressure enters the vessel, a plunger is actuated and the seal is held firmly against the opening.

Circle 219 on Reader Service Card

BLEEDER VALVE . . . which is semi-automatic and makes bleeding of air from hydraulic systems a fast fingertip operation is described in a bulletin released by Greer Hydraulics, Inc. The ease of operation is illustrated. Cross-section views show the consruction of the valve. All dimensions and part nomenclature are shown on drawings. Other uses including the dumping of air pressure in pneumatic systems are discussed. How it works, features, specifications are covered. Valve will withstand pressures up to 20,000 psi.

Circle 220 on Reader Service Card



ATLAS

TRADE MARK REG.

If you need a Reducing Valve that you can truly depend on—a trouble free valve—a High Pressure valve—one that will reduce pressures as high as 6,000 lb. per sq. in.—specify the

ATLAS Type "E"

HIGH PRESSURE REDUCING VALVE

shown at the left. High pressures are easy for this valve. It handles them *without shock*—oil, water, or air.

For over 50 years ATLAS has been making regulating devices *exclusively*—for all services. What is YOUR problem? Our experienced engineers will be glad to work with you.

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

253 South Street • Newark 5, New Jersey

Represented in Principal Cities

Zero maintenance

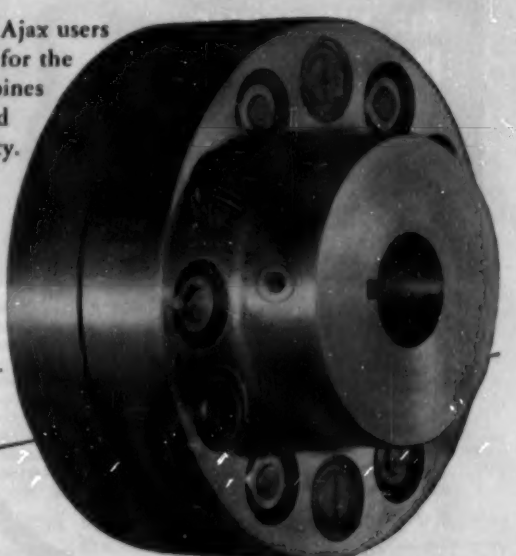
AJAX

RUBBER-BRONZE BUSHED FLEXIBLE COUPLINGS

The experience of hundreds of Ajax users throughout industry has been responsible for the statement—*"Maintenance Zero"*. Ajax combines long life, graphited bronze bearings and steel studs with rubber cushioned resiliency.

Every direct-connected machine deserves the protection of Ajax Flexible Couplings. Bearings, armatures and other expensive working parts are safeguarded by Ajax positive resilient drive. Down-time of machines and even entire departments is prevented.

Write for new Catalog.

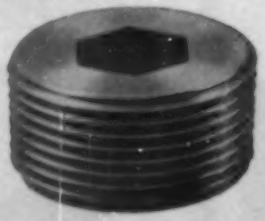


AJAX FLEXIBLE COUPLING CO. INC.

Representatives in Principal Cities

WESTFIELD, N. Y.

Circle 109 on Reader Service Card



UNBRAKO

dryseal-thread

PRESSURE PLUGS

seal tight

without compound

When UNBRAKO Pressure Plugs are tightened, major and minor diameters are positively sealed, pressure tight without sealing compound. UNBRAKO Dryseal-Thread Pressure Plugs, in a full range of sizes from ⅛" to 1¼" NPTF, are available from your local UNBRAKO distributor's stocks. Write for literature. STANDARD PRESSED STEEL CO., Jenkintown 2, Pa.

UNBRAKO SOCKET SCREW DIVISION

SPS

JENKINTOWN PENNSYLVANIA

USEFUL LITERATURE

Continued

AUTOMATIC PUMP SEQUENCE CONTROL SYSTEMS . . . for varying the number of pumps needed to satisfy fluctuating demands in multiple pump installations are described and illustrated in Fischer & Porter 4-page catalog 91-106. The principle of kinetic manometry, direct measurement of a constant percentage of main-line flow through an orifice and taps is used to actuate a float with an armature attached. Changes in main-line flow moves the float up or down causing armature movement through the electro-magnetic field of one or more inductance coils. This inductance change is transposed electronically to an electric signal that either stops or starts the pump.

Circle 221 on Reader Service Card

FLOW REGULATORS . . . New catalog sheets 3.40 and 3.41 released by Fluid Controls, Inc. show the ¼ in and ⅜ in flow regulators. The combination by-pass and restriction type regulator is used to maintain a constant flow when pump outlet varies or is greater than required for part or all of the system. The regulators can be used in series to provide several regulated flows from one pump or power source. The operation is explained very completely. A

Use

POWERMATIC

AIR HYDRAULIC

PUMPS

For Safe, Positive, Accurate Pressures to 25,000 p.s.i.

Size 9½" x 14" high
Weight 33 pounds

LONG LIFE

LOW COST

SMOOTH

FAST

PORTABLE

The air operated Powermatic hydraulic pump is engineered for continuous service at maximum capacity without overheating or overloading. Provides positive variable pressure control. Streamlined—no protruding parts to catch or damage. Hundreds of uses—operating rams, jacks, pipe benders, presses, hydraulic body and frame straighteners, lab testing, etc. Send for catalog.

Distributors Inquiries Invited

POWERMATIC SALES CO.

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Circle 98 on Reader Service Card

AIR-MITE AIR CYLINDERS

Low Cost Compact Powerful Rugged

AIR-MITE Cylinders—made in single or double acting series—in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling or lifting is required, AIR-MITE cylinders will meet your most exacting standards of dependability and long life. Write for complete catalog and prices.

1. Ground and polished steel ram
2. Brass, true-bore cylinders
3. High strength aluminum alloy cylinder heads
4. Bronze oilless ram bushing
5. Five steel tie rods
6. Brass base stems

4 Mounting Types

AIR-MITE

4415 W. CARROLL AVENUE • CHICAGO 24, ILLINOIS

Circle 4 on Reader Service Card

cross-sectional drawing shows the construction and identification of component parts. A dimensional drawing and price list are included.

Circle 222 on Reader Service Card

NEW CONDENSED CATALOG . . . The new hydraulic component line of The Hydraulic Power Division, The Hydraulic Press Mfg. Co. is fully described in catalog No. 1101. It covers the entire line but in less detail than the nine individually bound catalogs, recently issued on the line of products. The catalog was planned to serve as a comprehensive guide to the line. It is profusely illustrated and planned to give quick recognition of general specifications.

Circle 223 on Reader Service Card

DIFFERENTIAL PRESSURE POTENTIOMETER . . . of a new diaphragm bellows-type in standard ranges from 0-1 to 0-30 psi is described with complete technical information in a data sheet #508, released by Bourns Laboratories. Included are photographs, an outline drawing, a temperature vs deviation graph and detailed specifications covering linearity, hysteresis, resolution and the effects of vibration and acceleration. The instrument measures the difference between two pressures applied to the parts of the instrument.

Circle 224 on Reader Service Card

REPUBLIC

VALVES

INDUSTRIAL • CHEMICAL • AIRCRAFT

What! PLUG VALVES THAT TURN EASILY AT 65° BELOW!! WITH NO LUBRICANT!!!

Up to 250°, down to −65° F, is the range of Republic's LO-TEMP selector valve. Easy turning, positive sealing, at pressures to 100 psi. Tapered TEFLON plug requires no lubricant, and is not affected by acids or alkalis.

Aluminum body for aircraft and general use, stainless steel for chemical, food, and dairy industries. Angle, 2, 3, 4-way, with or without drain, flanged for panel mounting.

Write for Bulletin No. 754. Distributors in principal cities from coast to coast.

RM REPUBLIC MANUFACTURING CO.

1930 WEST 77TH STREET • CLEVELAND 2, OHIO

134

EVEN THE BEST CAN BE IMPROVED

Gerotor offers its

New QDB series

of small capacity pumps as proof!

Gerotor has redesigned its series of small capacity pumps to give even more . . .

- **FLEXIBILITY**—the QDB can be operated in either clockwise or counterclockwise direction by simply changing the position of one internal plug!
- **RANGE OF APPLICATION**—the QDB can be obtained with an extended shaft to operate another pump in tandem, off of one motor!
- **DEPENDABLE SERVICE**—the QDB is built to give more dependable service over a longer service span than any comparable pump. Its longer life reduces your maintenance and replacement costs.

If you have need for pumps in the QDB range, call on Gerotor.

Gerotor makes a complete line of hydraulic pumps in ranges from .4 g.p.m. to 40 g.p.m. The Gerotor engineers can help you solve your hydraulic pump problems. Write for *free literature* and full particulars.

Check this capacity table . . .

Type	Delivery g.p.m.—1800 r.p.m. Discharge Pressure p.s.i.				
	0	250	500	750	1000
QDB .4	.42	.40	.38	.35	.31
QDB .75	.84	.80	.78	.73	.66
QDB 1.5	1.67	1.62	1.57	1.50	1.42

GEROTOR MAY CORP. - Box 86 - Baltimore 3, Md.

GEROTOR

HYDRAULIC PUMPS & MOTORS

Circle 131 on Reader Service Card

IMPERIAL TUBING TOOLS

. . . for better tubing connection work!

All the tools you need for cutting, flaring and bending J.I.C. steel tubing, stainless steel tubing as well as copper and aluminum tubing.

No. 437-F 37° FLARING TOOL. One compact tool flares 6 sizes of tubing—3/16", 1/4", 5/16", 3/8", 1/2", and 5/8" O.D. tubing. Has easy, single lever clamping. Smooth heat treated sliding dies clamp tubing without scoring it.

No. 537-F 37° FLARING TOOL FOR 4 LARGER SIZES. Has rollers in flaring cone which make flaring of larger sizes easier. Automatically burnishes flares assuring tighter joints. For 3/4", 7/8", 1", 1-1/4", O.D. tubing.

Ask for Bulletin 3017

Also a complete line of tube cutters, 45° flaring tools, tube benders, reamers, etc. **No. 274-F** Tube Cutter and **No. 270-F** Gear Bender are illustrated.

See Your Supply House

THE IMPERIAL BRASS MFG. CO., 1242 W. Harrison St., Chicago 7, Ill.
In Canada: 334 Lauder Ave., Toronto, Ont.

IMPERIAL PIONEERS IN TUBE FITTING AND TUBE WORKING TOOLS

WIGGINS **INST-O-MATIC** COUPLINGS

QUICK—DISCONNECT

3000 psi

Manual Quick Disconnect (Push-Pull Positive Action)

Automatic Quick Disconnect (Breaks Away at Pre-determined Weight Load)

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SIZES: 1/4" TO 2 1/2"

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USEFUL LITERATURE

Continued

QUICK COUPLING . . . Catalog R-225 has been released by Roylyn, Inc. New up-to-date engineering changes are incorporated. These fittings, made in sizes from ¼ to 6 inches require only a quarter turn to actuate.

Circle 227 on Reader Service Card

ACCUMULATORS . . . A catalog has been released by Superior Pipe Specialties Co. listing by part number the hydropneumatic piston type accumulators available. Much detailed information is given for each unit, including instruction data, component parts, general design notes, net gas volume, maximum oil volume and oil port size. A cross-section view shows construction and identification of component parts. Accumulator oil volumes at various operating pressures are shown for each unit.

Circle 228 on Reader Service Card

FLOW CONTROL VALVES . . . A new 4 page two color bulletin 53-35, describing these valves for machine tool and welding machine oil hydraulic systems, may be obtained from Vickers, Inc. Flow control circuits, performance curves, installation data and complete specifica-

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...assures non-stop production flow with BIG savings in maintenance and investment cost!

The production magic of "AUTOMATION" demands faultless performance—as the failure of one important component of "automation" machinery and equipment can shut down an entire manufacturing process.

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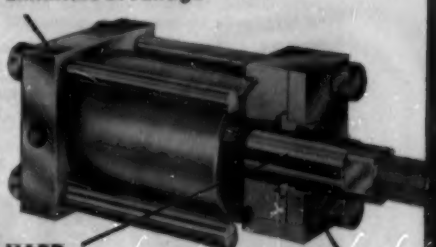
Consult our engineering department or local representative. And write for complete information on this and other interesting applications and for our FREE Cylinder Bulletins A-105 and H-104.

SOLID STEEL HEADS, CAPS and MOUNTINGS Eliminate Breakage



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Cyl. Dia. Bore	1"	2"	3"	4"	5"	6"	10"	12"	15"
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2"	26.24	27.88	28.32	28.76	29.64	30.52	31.40	32.28	33.60
2½"	32.36	34.12	34.68	35.24	36.36	37.48	38.60	39.72	41.40
3"	35.04	37.28	37.92	38.56	39.84	41.12	42.40	43.68	45.60
4"	40.84	43.68	44.52	45.36	47.04	48.72	50.40	52.08	54.60
4½"	48.96	51.92	52.88	53.84	55.76	57.68	59.60	61.52	64.40
6"	66.60	70.80	72.20	73.60	76.40	79.20	82.00	84.80	89.00
8"	.....	126.80	129.20	131.60	136.40	141.20	146.00	150.80	158.00

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A 8003-½

USEFUL LITERATURE

Continued

tion tables are given. Gasket mounted valves in a series of models for ¼, ⅜, ¾ and 1¼ in standard pipe sizes are presented. One-quarter in size valves with integral check valve for reverse free flow are discussed.

Circle 229 on Reader Service Card

CALIPER-GAGE . . . The gage is adapted to checking not only "easy to get at" inside diameters, but also the diameters of "O" rings and snap ring grooves, recesses, reliefs, the bottoms of bores, out-of-roundness and taper. The gage can be adjusted to the diameter of the bore or groove, then removed and checked with micrometers. The various models available, capacities and prices can be obtained by writing for literature from Mutual Engineering Service.

Circle 230 on Reader Service Card

AIR CYLINDERS . . . Bulletin 3340 released by A. Schrader's Son, Div. of Scovill Mfg. Co. Inc., presents the company's complete line of single and double-acting cylinders. The various mountings available with each group are described. Each type is illustrated and shown in section. Specifications are given for both "with-

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Circle 50 on Reader Service Card

Circle 84 on Reader Service Card

out cushion" and "with adjustable cushion" for the double-acting cylinders. Many control valves are shown including 2-way, 3-way and 4-way in all the types available.

Circle 231 on Reader Service Card

"O" RING PACKING . . . Greene, Tweed & Co. announce the marketing of their new molded Palmetto "O" ring packing for static and dynamic applications. Detailed literature has been released, covering the "O" ring and may be obtained by writing the company.

Circle 232 on Reader Service Card

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Circle 233 on Reader Service Card

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Circle 11 on Reader Service Card

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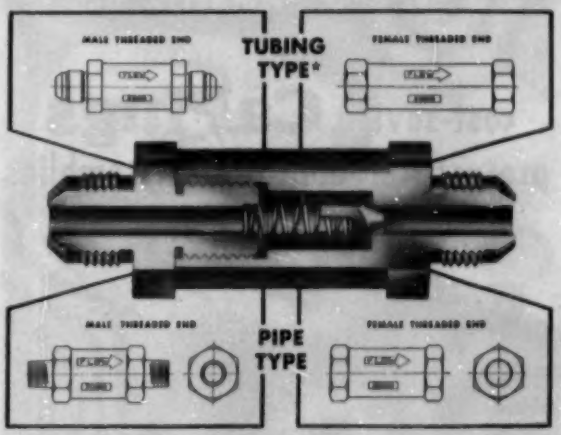
FULL VOLUME FLOW • POSITIVE CHECKING



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Material: Steel, stainless steel, aluminum, brass, malleable iron

Pressures: 0-10,000 psi in steel; 0-1500 psi in other metals listed here

Sizes: Tubing, ¼" — 1"; Pipe, ¼" — 1½"

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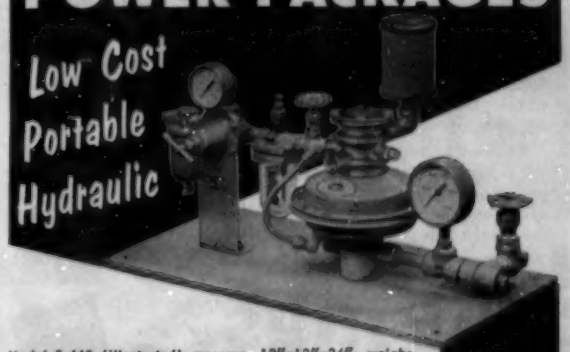

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Ad No. 225

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USEFUL LITERATURE

Continued

new 16 page illustrated booklet offered by Fenwal, Inc. The booklet includes application ideas, installation tips and suggested circuits for utilizing the detector. Also discussed is the principle of operation of this device, which has no moving parts. The unit is hermetically sealed and is installed directly in the tank of air stream being monitored. Given also are detailed specifications, including response curves, on the performance, operation and electrical characteristics of the unit under various conditions of use.

Circle 234 on Reader Service Card

DIRECTIONAL AND FUNCTIONAL VALVES . . . of 3000 psi are described in catalog number 841, prepared by Hydraulic Power Division. The Hydraulic Press Mfg. Company. 35 different types of valves are cataloged with very complete information on each type. The various styles of each valve are illustrated along with JIC diagrams. All data is given including dimensions, features, operation, model number and spools. A section of the catalog is devoted to subplates. Other catalogs are available on pumps, motors, power units, cylinders and accessories.

Circle 235 on Reader Service Card

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Parallel Application

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For Mobile and General Industrial Applications.

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Center sections are available making additional Controls in this Multi-unit.

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Circle 130 on Reader Service Card

Hydraulic Control for Chucking Machine

Concluded from page 71

at approximately 40 psi. This would, of course, result in decreased torque for C5 clutch. This was considered undesirable from the standpoint of excessive slipping and premature wear of the C5 clutch plates.

To eliminte this condition, the 60 psi relief valve was moved to a point in the circuit where it could reduce the pressure equally on both clutches. The valve shown in Figure 3 was developed and an experimental valve was built and tested. The additional force put on the end of the relief valve by the plunger and piston opens the relief valve the amount necessary to by-pass more oil to the discharge side and reduces the pressure in the circuit. Tests showed the pressure at the two clutches to be the same (60 psi) as was intended. This new valve was incorporated into the production units.

This transmission is now in production for a new, single spindle automatic. It is also replacing the four-speed transmission in the present smaller machine with a gain of two automatic speeds, reduced speed increment and the elimination of four pairs of change gears.

The new unit will make possible higher production with lower manufacturing costs for these machines and is a further step in the advancement of machine tools toward low cost production.

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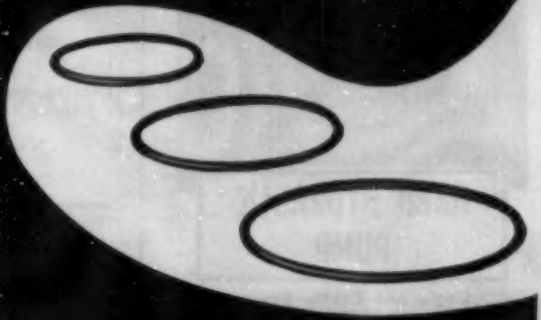

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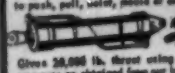

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⅜ - ½ - ¾ Inch
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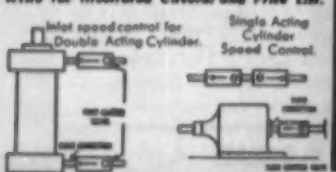

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JULY, 1954

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PRESSURE . . . 2,000 psi heavy-duty . . . 3,000 psi non-shock.

SIMPLICITY . . . no tie-rods . . . no retainer rings.

hydro-line *Manufacturing Co.*

8888 PIKE ROAD • ROCKFORD, ILLINOIS

BOOST PUMPS

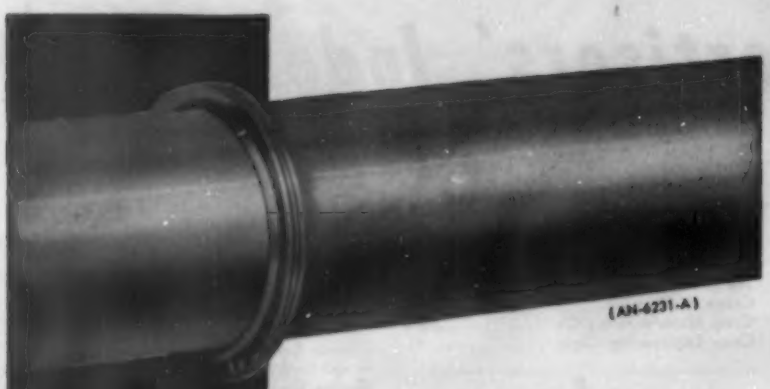
Boost 100 PSI. air pressure to 10,000 PSI, fluid pressure for $173.25 (FOB Gardena, Calif.). Eight standard models for output fluid pressures of 1,000 to 30,000 PSI. Special models for lower or higher pressures.

Applicable wherever low volume output at high pressures is the requirement. For oil or water service. Complete power packages also available. Send for bulletins.

SPRAGUE

Engineering and Sales Corp.

1144 West 135th Street, Gardena, California



KEEP DIRT OUT!

Dirt means *down-time* for your hydraulic equipment! Dirt means damage to packings, cylinder walls and internal parts. STOP LOST PRODUCTION due to constant replacement of packings. Keep dirt out with HYDRO-WYPE Scraper Rings, and you keep your equipment at peak efficiency longer. HYDRO-WYPES are precision-made for the precision-fit that keeps piston rods clean for more than 2,000,000 cycles—and at low cost, too. They meet or exceed the requirements of MIL-S-5049. Check these HYDRO-WYPE features:

- **Sharp, clean scraping edges!**
- **99% to 99.5% rod contact!**
- **"Pre-Stressed" for controlled break-out friction!**
- **Approved Specification MIL-S-5049!**
- **Precision-fit!**

HYDRO-WYPES are widely used today by manufacturers of machine tools, aircraft and marine equipment, power steering units, railroad and road-building equipment, farm machinery—in all types of **hydraulic** and mechanical components.

Look for the HYDRO-WYPE decal when you buy hydraulic and pneumatic equipment. You can tell the quality of a product by the company it keeps.

WRITE TODAY FOR COMPLETE DETAILS AND CATALOG TO

atsco 4217 North Main Street, Dayton 5, Ohio

Nation-wide sales and service representatives for

Gadgets, inc. Specialists in Hydraulic and Electrical Equipment.

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"It's designed right—just the way I'd do it myself."

■ *a design engineer recently paid us this compliment while examining one of our cylinders. We pass it on to you with the idea that you too may find Pathon cylinders designed right for the job on your cylinder applications.*

As a designer...

YOU GET EVERYTHING YOU WANT IN A HYDRAULIC CYLINDER

Pathon

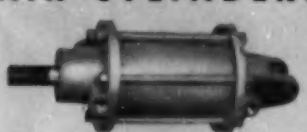
HYDRAULIC CYLINDERS

are made in eight standard models and can be adapted to practically any application. Write us today for Bulletin No. 22. We're glad to help you on any cylinder problem.

- **COMPACTNESS**
- **LOW STRESS CONCENTRATION**
- **INCREASED STRENGTH ... AND FATIGUE LIFE**

All Pathon Hydraulic Cylinders in Series RH 2000 P.S.I. and QH 1000 P.S.I. use a single screw head to attach the head to the body of the cylinder. This design provides an absolute minimum of physical size and at the same time reduces stress concentration throughout the barrel to the head attaching area. You get a *plus factor* in shock loading with increased strength and fatigue life. Your Pathon Hydraulic Cylinders are simple and sturdy in construction, require much less maintenance.

Pathon AIR CYLINDERS



DIRECTIONAL CONTROL VALVES

We also manufacture a complete line of Air Cylinders and Directional Control Valves. Write for information.

Pathon MANUFACTURING CO.

3823 PACIFIC AVE.
CINCINNATI 12, OHIO

Circle 95 on Reader Service Card

Franchise Circulation GETS A NEW PARTNER:

Action Audit

Now for the first time, the WHOLE story of a magazine for Advertisers

Franchise Circulation

The problem confronting every advertiser is to have his sales message read by the people upon whom his salesmen is calling. To attain that is the perfect integration of advertising to sales. Industrial advertising does a much more effective job backing up salesmen than it does to generate its own direct sales.

The Industrial Publishing Company has developed since 1932 what is probably the most effective means for reaching a sales market that has been devised in industrial advertising.

Wholesale distributors in the fields served by The Industrial Publishing Company's magazines, subscribe to the magazines for their best customers and prospective customers. They pay monthly for each subscription, and the people for whom they subscribe are the active buyers called on daily by their own salesmen. The lists are corrected monthly, assuring that the circulation remains sensitive to the personnel turnover in business and industry.

How do you know we reach the right man for you?

Through ACTION AUDIT. This is the measuring stick which analyzes and particularizes the quantity and the QUALITY of the readers of your and your competitor's advertisements. No other method for such determination has heretofore been devised.

What is Action Audit?

The Industrial Publishing Company asked advertising buyers across the country what they needed to know in choosing publications.

All of the answers fell generally into the groups of "Who reads it?", "How does it reach him?" "What is the degree of the readers' interest?" and "How can the buyer cretainly know these things?"

The editorial content of a book is tangible; quantitative circulation measurement has become almost standard practice; surveying has reached higher levels of value to the advertising practitioner. But there are still areas which need greater light.

"Action Audit" is the means of ascertaining and disclosing to the buyer, what happens when a magazine goes to the right man, in the right place, at the right time.

The beginning of a measurement

The Industrial Publishing Company's magazines solicit inquiries for the advertiser by means of a card which the reader may send for further information or action. They are sales leads but they are much more. THEY ARE AN INDEX OF WHO IS READING; OF WHAT HE IS READING.

Why is Action Audit useful to an advertiser?

Publishers' presentations have historically been a "putting-of-the-best-foot-forward". A dozen points about a book have been taken out of context and placed in a favorable light before potential buyers. An advertising buyer about to make a decision has had a hodge-podge of claims and accusations upon which to form a judgement . . . with a suspicion that he also had missing parts.

Action Audit is a presentation by a publisher of the TOTAL STORY OF HIS BOOK, without deletion or expansion of fact. The advertising buyer sees the magazine exposed in all its nakedness and is able to make a fair estimate, with which he feels secure. He can defend his choice in his own mind and to other people. That is why Action Audit is essentially useful, because it is the WHOLE story.

ACTION AUDIT:

- Gives you FACT about reader traffic.
- Demonstrates the news value of business paper advertising.
- Takes circulation and market out of statistics and shows you PEOPLE . . . people in action . . . people interested in what you sell.
- Reflects interest in types of sales appeals.
- Indicates new pools of buyers every month.
- Shows publisher's sensitivity to reader interest and purchasing power.
- High-lights need for rapid, efficient inquiry handling for sales effectiveness.

APPLIED HYDRAULICS MAGAZINE

1249 ONTARIO STREET • CLEVELAND 13, OHIO